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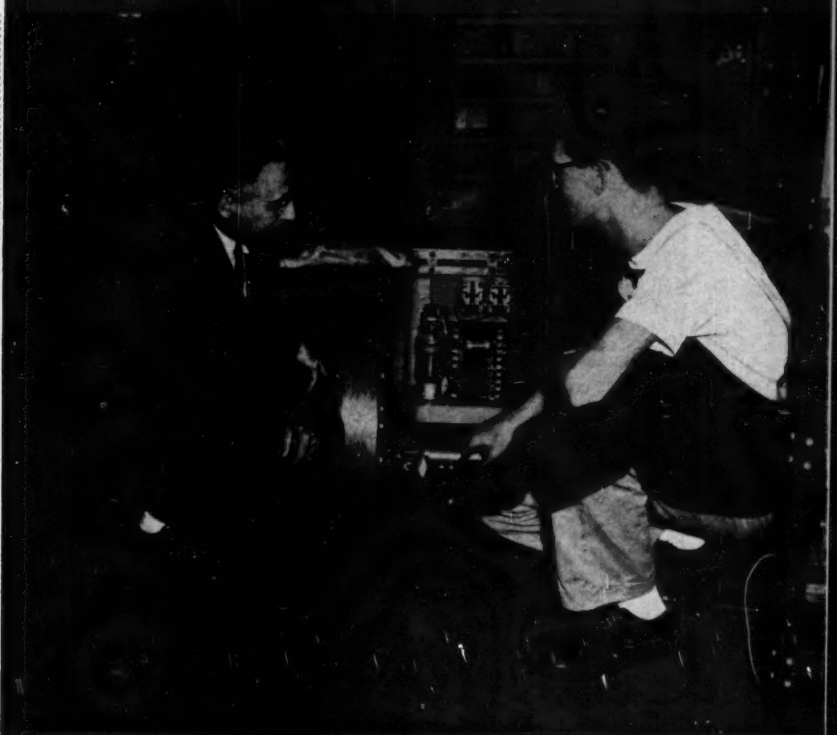
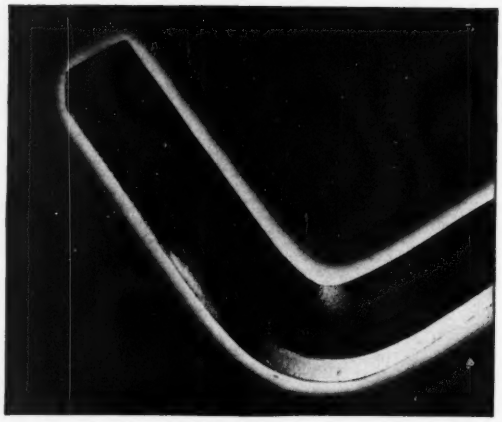


FEBRUARY, 1953

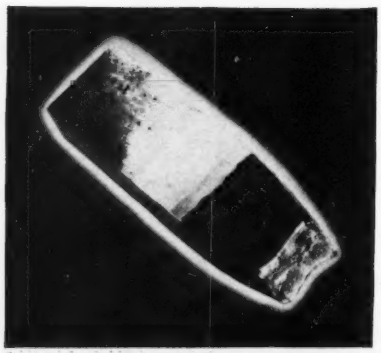
VOL. 18, NO. 5

25 CENTS

90° BEND AT 98 BELOW! This sample, flame-cut from 1" CARILLOY T-1 plate, was chilled to –98°F., and then bent to a full 90° angle. Even though the raw, flame-cut edge made up the outer radius of the bend, there was no sign of failure!



New steel has yield strength of over 90,000 psi yet remains ductile at 70°F. below zero even after welding or flame-cutting



100% WELD STRENGTH—Tensile tests on T-Steel specimens like these were made to determine the strength of the welds. These welds develop the full strength of the parent metal. Note that breaks occur outside the heat-affected zone, showing that the heat of welding has not harmed the strength of the material. No special pre-heating or post-heating treatments are required beyond those used with ordinary structural steels.

THIS remarkable steel, U·S·S CARILLOY T-1, offers great promise to those who need a super-strong steel that can be welded, flame-cut or cold-formed.

CARILLOY T-1 is unique. It differs from all other very strong steels in important respects: Its yield strength of over 90,000 psi is *not* lowered by welding or flame-cutting. In these operations, no pre-heating or stress-relieving is required. As a result. CARILLOY T-1 can be readily field welded.

Usually, welded steels of such high strength level suffer a loss of ductility at low temperatures unless elaborate precautions are taken in the welding operation. In striking contrast, notched bend weldability tests show that T-1 steel will remain ductile and tough down to the lowest atmospheric temperatures. As a matter of fact, T-1 steel, after flame-cutting, has been bent to a full 90° angle at temperatures as low as –100°F., without any sign of cracking.

Service tests show that CARILLOY T-1 is well suited for extremely abusive service, and the fact that it can be field welded should greatly lower the difficulties and cost of major repairs. In applications in which tension is the principal stress, thicknesses can often be reduced to one-third of those required with ordinary structural steels.

CARILLOY T-1 steel is another result of United States Steel's active research program which has enabled manufacturers to improve their production methods and make better products, too. All over the country, trained U. S. Steel engineers and metallurgists are constantly at work on problems like this, finding better ways to make and use steel. United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

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Paul Murphy, Jr., received his BSME degree from Purdue in 1941. After four years of service as a Naval engineering officer, he joined Detroit Edison as a junior engineer, in the Production Department and progressed in less than seven years to the position of Boiler Room Engineer in charge of all 12 boilers at Detroit Edison's Delray plant, a position of responsibility that includes the supervision of methods, procedures, and maintenance scheduling for boilers and coal handling equipment.

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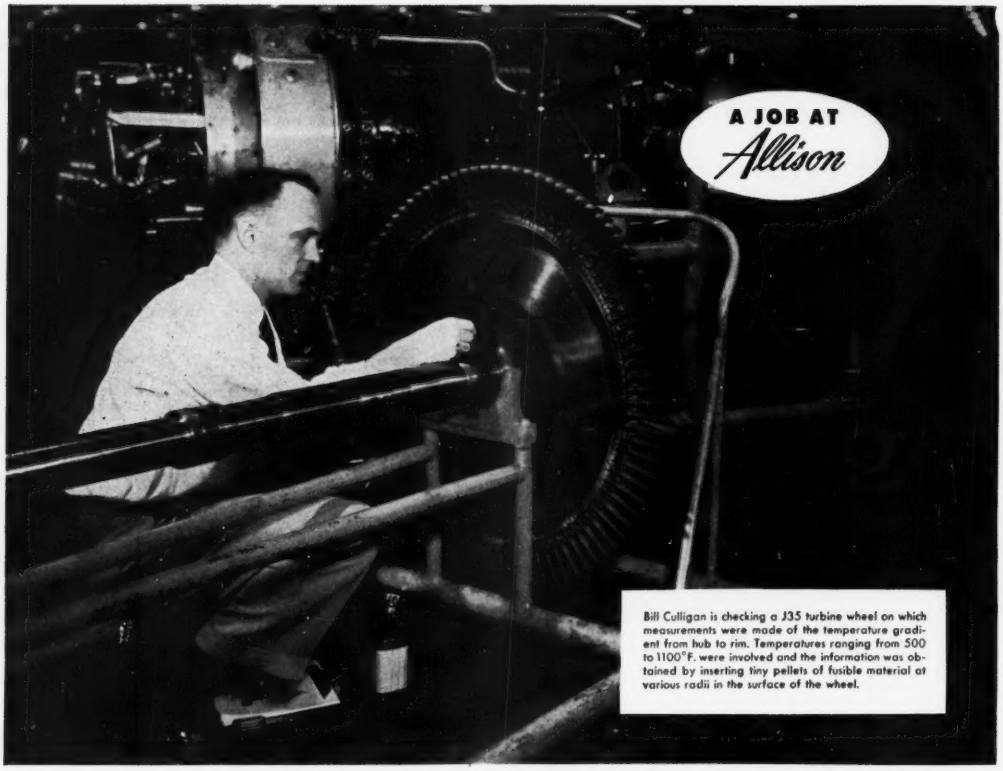

Bill Culligan is checking a J35 turbine wheel on which measurements were made of the temperature gradient from hub to rim. Temperatures ranging from 500 to 1100°F. were involved and the information was obtained by inserting tiny pellets of fusible material at various radii in the surface of the wheel.

● William L. Culligan, Jr. received his B.S. and M.S. degrees in Aeronautical Engineering from the University of Michigan in 1945 and 1947. His first two years with Allison as a junior engineer were devoted to gaining direct experience in the operation of jet engines in the Experimental Test Department. In December, 1949, Bill was promoted to Experimental Engineer and has been specializing in applying improved instrumentation to jet engines as a means of obtaining better data for analyzing and predicting their performance. This has included some special "jet rakes" to obtain pressure and temperature data in the hot jet exhaust of engines on the test stand and in flight. There also were such things as quartz windows and periscopes to permit viewing the combustion inside the engine.

On one occasion he spent six weeks assisting in Air Force tests of an Allison engine at Eglin Field, Florida, where the inlet air temperature to the engine was varied from minus 65°F up to a "hot day" temperature of 110°F.

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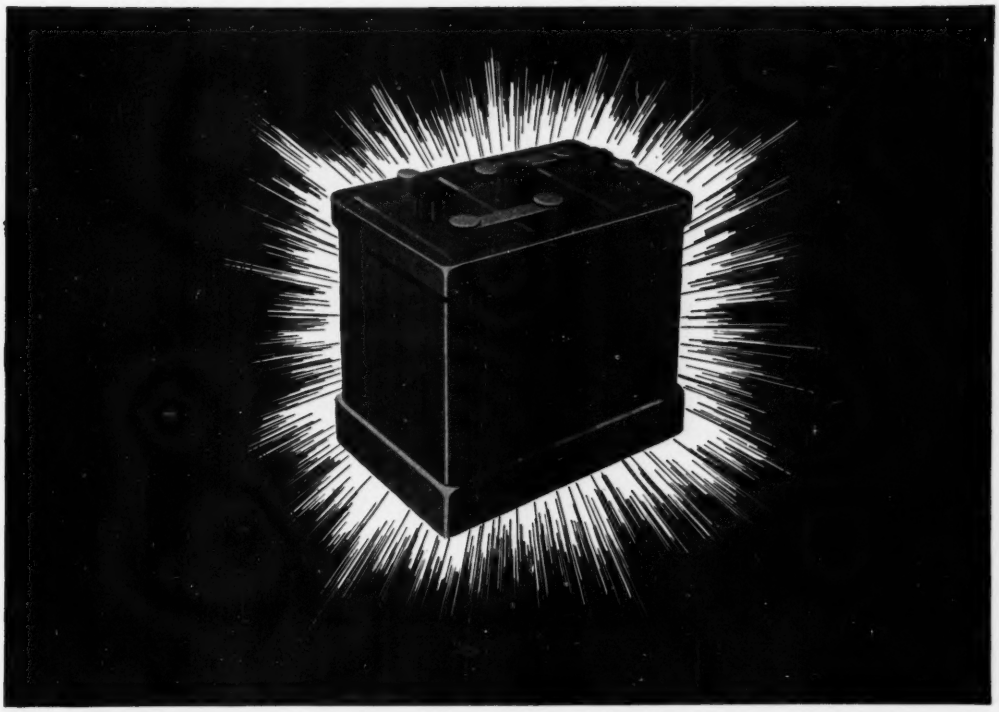

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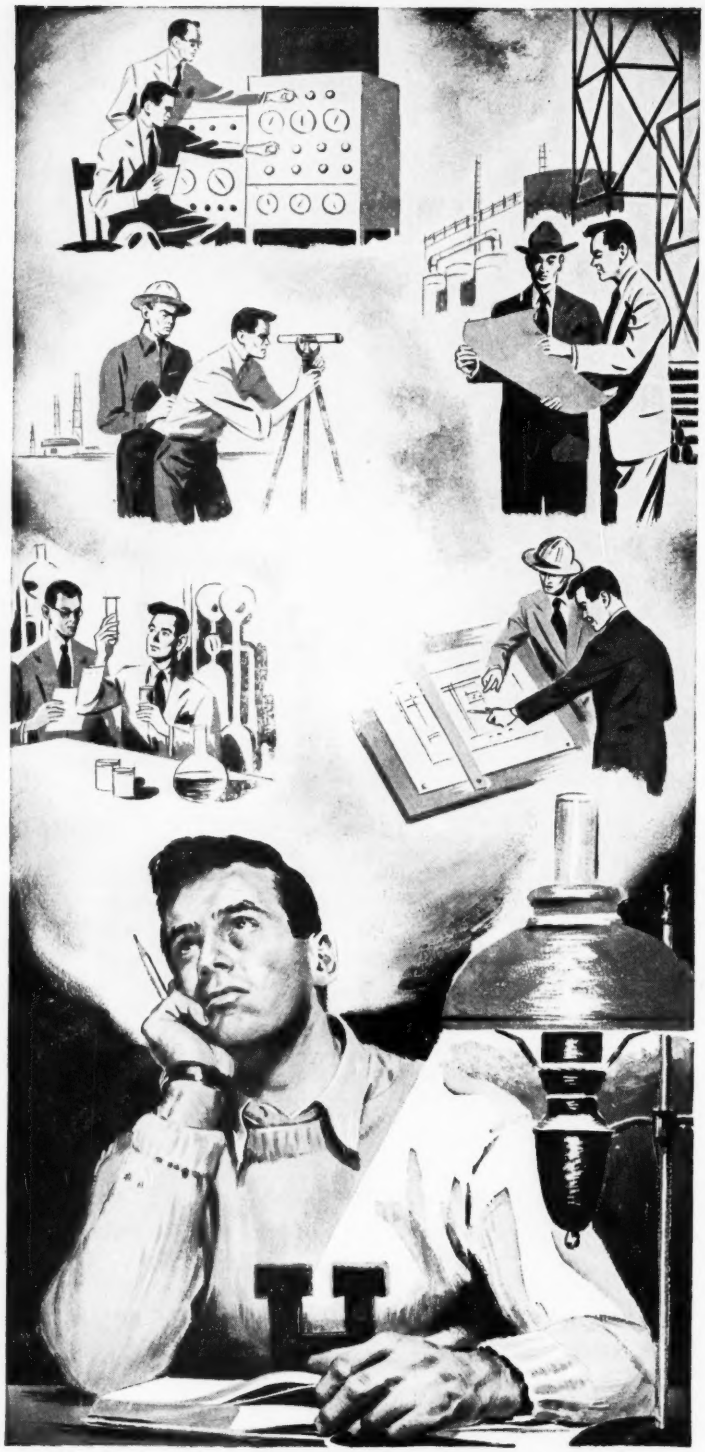

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COVER—George Ashley, EE '54, explaining the control unit of a new G. E. automatic feed a-c welder to Prof. E. M. Strong, the coordinator of Cornell's Industrial Cooperative Program. See page 32.

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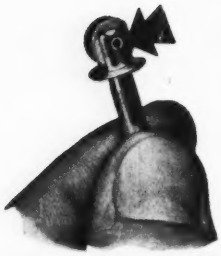
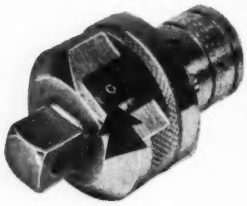
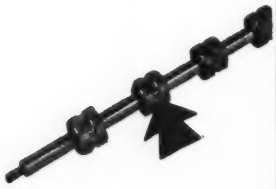


Replacing a rivet

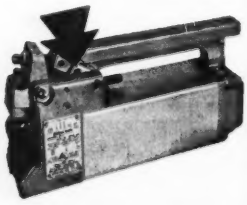
. . . a hinge pin



. . . a stop pin

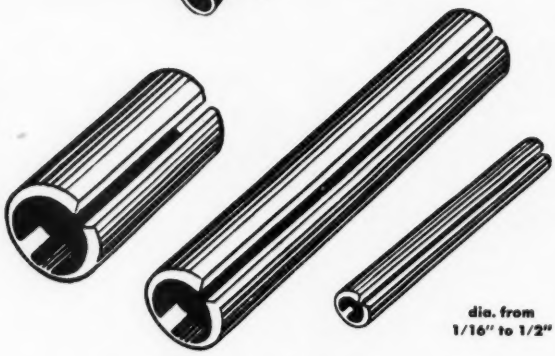


. . . a set screw



. . . a bolt and nut

ROLLPIN



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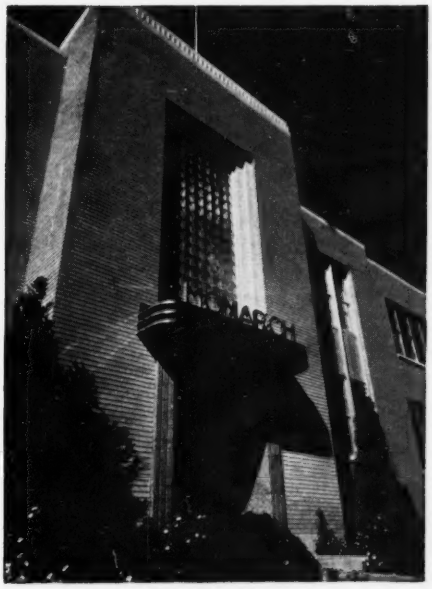

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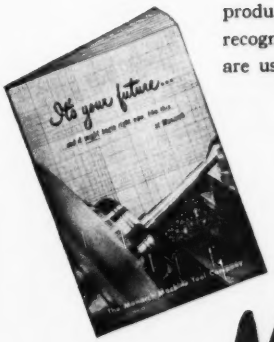

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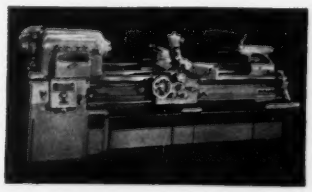

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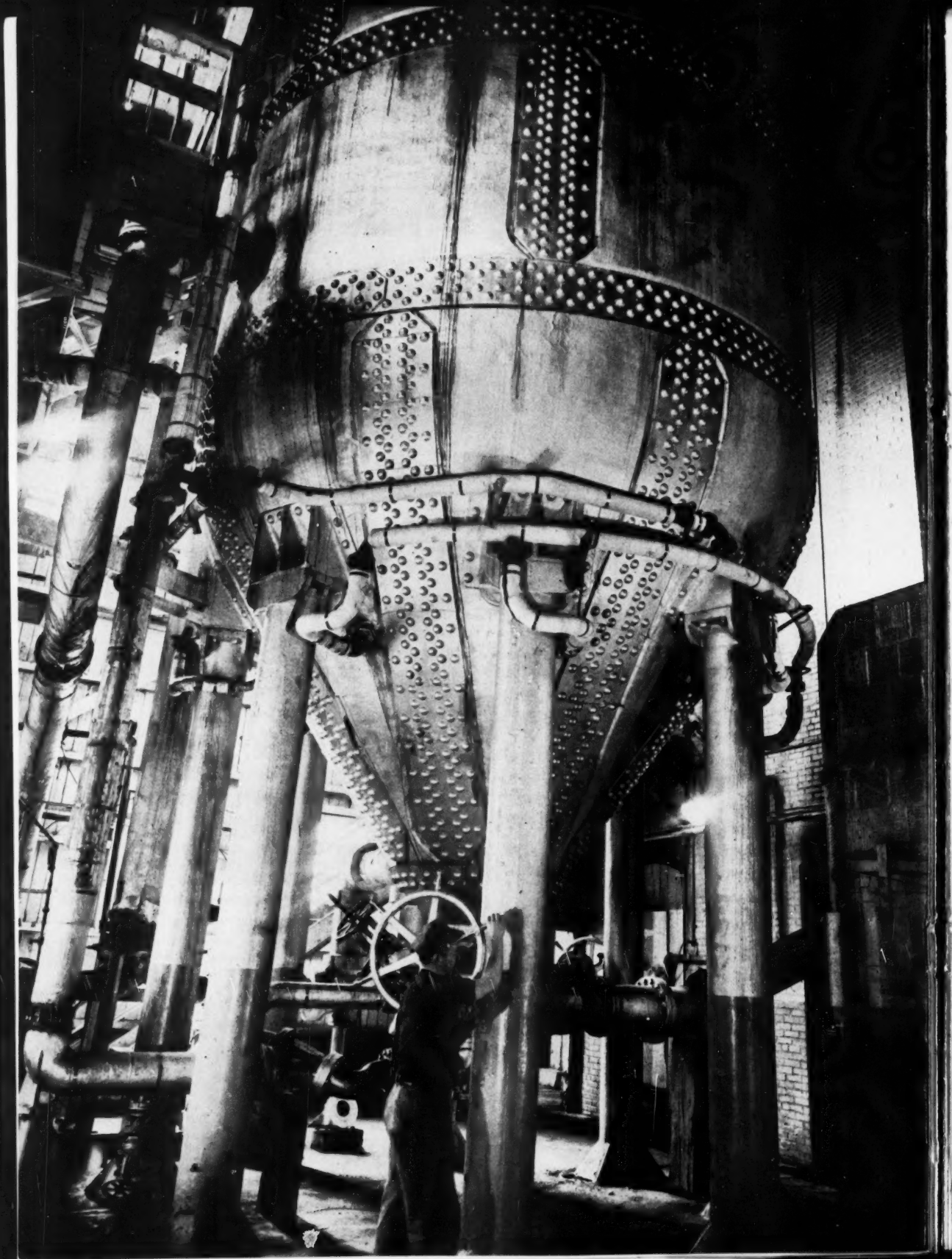


Papermaking and Paper's Uses

By ROBERT M. STUCKELMAN, EE '54

Paper is the material of a thousand uses. It is the material upon which magazines, newspapers, and books are printed; it is used to make posters, to write letters, keep records, and wrap packages. It is used to make cigarettes and recording tapes; it is an electrical insulator. It papers walls and has many other purposes.

The History of Paper

But this great development of paper took thousands of years. It was fully 2000 years ago in China that a man named Ts' ai Lun made the first piece of paper. He pounded the inner bark of a mulberry tree into pulp, added water to this, and dried the mixture in flat matted fiber sheets upon which messages could be written. This discovery of Ts' ai Lun was destined to take a long time before it became a commercially manufactured reality.

It took 600 years for the secret of papermaking first to work its way over to the fringes of western civilization, and then it was not until 1799 that the first major improvement in the process was made. In that year a Frenchman, Louis Robert, patented the first modern papermaking machine. Then in England the Fourdrinier brothers improved the machine and developed a papermaking machine which, in principle, is the same as that used today. The papermaking machines of today are in fact named after their inventors and are called *Fourdriniers.*

Even with the advent of the Fourdrinier, papermaking was a far cry from what it is today. In the early nineteenth century, as in the days before papermaking machinery, almost all paper pulp consisted of the fibers of ground rags. Finally, in the middle of the nineteenth century, Kellar, a German, went back to the trees as a source of paper pulp. He developed a mechanical process for grinding wood and adding water to make pulp. A few years later an Englishman found that he could make pulp by cooking wood chips in a caustic soda solution.

In 1865 the United States took its largest stride in the papermaking industry when a chemist named Benjamine Tilghman discovered the sulphite process for cooking wood. This process of the chemical treatment of wood to make paper paved the way for this country, with its vast forests, to become the leader in the industry. The growth has been so great that today the United States produces nearly half the world's pulp and paper in over 700 paper mills.

Today paper is made from both wood and rag pulps. Some consists entirely of rag pulp and some consists of various percentages of rag pulp, but most of it is entirely or almost entirely made of wood pulp. In fact, about 97 percent of this country's paper comes from wood.

The actual process of making paper is very interesting. The flow chart (see page 10) will prove an enlightening aid in following the description below.

Preparing the Pulp

The trees from the forest (1) come to the mill and are debarked by any one of several processes. The bark can be mechanically cut off or peeled off, or, as shown on the chart, the trees can be hydraulically debarked (2) by being rotated under a strong stream of water.

With the barks removed the logs are fed into a chipper (3) which cuts them into chips which are from ½ inch to 1 inch long and about ⅛ inch thick. The chipped wood is then fed into a *chip screen* (4) which separates the chips from the large slivers of wood and from the sawdust. This is accomplished by feeding the chips onto a constantly agitated screen which allows the chips and sawdust to fall through while it stops the large slivers. A screen below this stops the chips but allows the sawdust to fall through.

The chips are then fed into what is called a *digester* (5). Here the lignin, which binds the wood fibers together, is dissolved, leaving a mass of separate cellulose fibers. This is done by cooking the chips from nine to twenty hours in a mineral acid liquor under steam pressure. When finished, the mixture, called pulp, is blown out into a *blow pit* (6).

The pulp must be purified and improved before it can be used for making paper. First it must be made thicker by feeding the watery pulp onto a revolving wire cylinder (7) and drawing the water out by internal suction. The thick pulp is then fed into a *bleach cell* (8) where it is mixed with chlorine. After bleaching, some of the larger impurities are removed from the pulp by having it flow over the baffles of a *riffler* (9). Heavy dirt and impurities settle to the bottom and are held back while the light pulp flows over the top of the baffles.

Next the chlorine bleaching agent must be washed out of the pulp. The pulp is fed onto a revolving wire mesh cylinder (10). There a stream of water is played against it after which the water, together

This digester cooks wood chips with an acid liquor to make paper pulp.
—Hammermill Paper Co.—AFPI Photo

with the bleach, is sucked out through the wire mesh.

The washed pulp is then deposited on the other side and fed into a beater called a *Hollander tub* (11). Here a toothed roller beats and rubs the pulp fibers against the bottom of the tub. This beating frays the fibers and makes them shorter so that they will form a smoother and stronger sheet of paper. Fillers, sizers, and colors are added in the Hollander tub. The filler makes the paper smoother and more receptive to color; the sizing makes the paper slick and more water and ink resistant.

The *Jordan* (12), the next machine used in the process, further shortens and frays the fibers with a series of rotating knives.

The pulp is then fed into the *head box* (13) which stores it until it is ready to be fed into the papermaking machine, the *Fourdrinier* (14).

Making Paper

The Fourdrinier has a continously moving fine mesh, bronze wire screen upon which the pulp—which is still 99 percent water—is evenly spread. The weight or thickness is controlled by the relation between the speed of the moving screen and the rate at which pulp is fed to the machine. The screen is agitated from side to side as the water is drained and sucked from the pulp, and the cellulose fibers interweave to form a continuous sheet. This sheet then passes to a wool felt belt which carries it between several pairs of heavy rollers; these squeeze out more water. It is then run over a series of steam-heated *drying rollers* (15). The length of the series of rollers may vary from 20 to 350 feet depending upon the thickness of the paper being dried. The drying is accomplished by heat, pressure, and suction.

The dried paper is then run through the *calender stack* (16). This is a series of polished cast iron rollers which "iron" the paper just as a shirt is ironed. The more rollers in the calender stacks, the smoother finish the paper will have.

The next step is to roll the finished paper into large rolls. These rolls are later rewound into smaller rolls (17). This rewinding process, in addition to putting the paper on smaller, more convenient rolls, prevents the paper from developing a curl in one direction.

Finally the paper is taken from the rolls, cut to size, trimmed, and packaged for shipping.

The process described here is the most common process for making paper from wood pulp. Some processes for making special papers include a few more intermediate steps while some processes for making coarser papers omit some of the refining steps, but they are the same in principle. Rag papers are made in essentially the same manner except that the pulp is prepared from different raw materials.

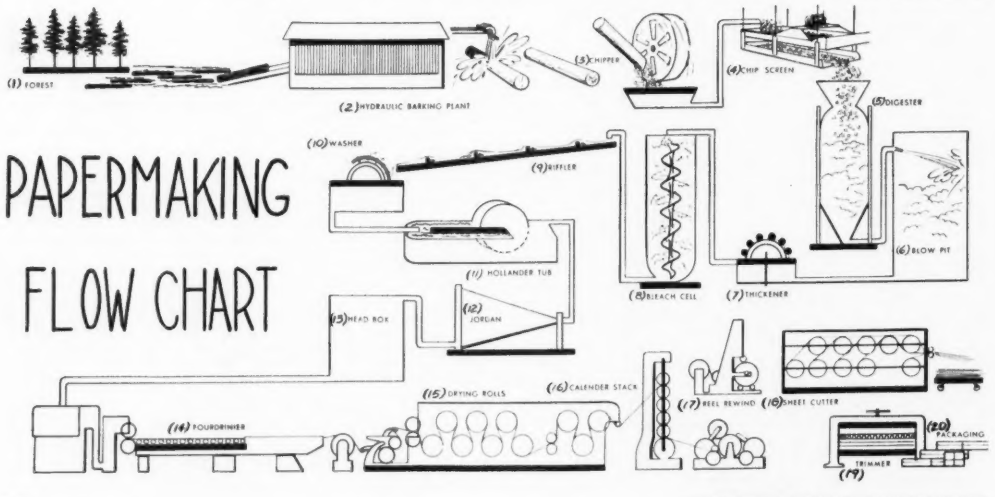
Common Uses of Paper

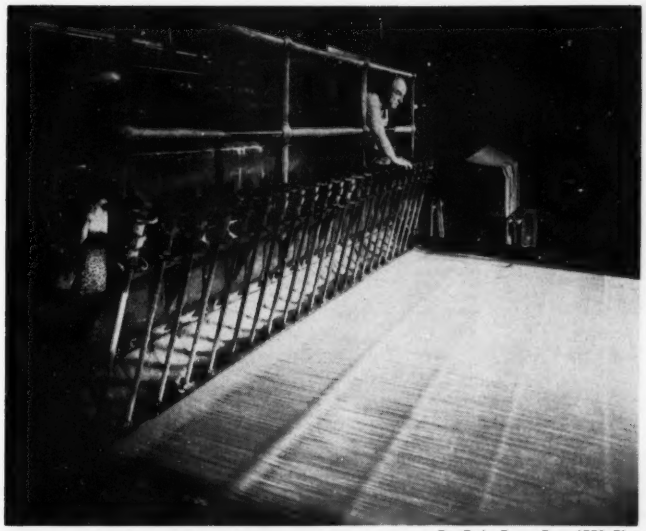
The finished product, however, takes many forms, the most common and most widely used being fine paper. Fine paper is the paper used for printing, mimeographing, writing, drawing and blueprinting. It comes in a variety of surfaces from very rough to smooth coated, such as the type this magazine is printed on; it has a variety of surface properties with some papers taking ink very well and some absorbing and spreading it as a blotter would do; it comes in a variety of strengths, and is available in any thickness from thin tracing paper to heavy oak tag.

Another major class of paper is kraft paper. Kraft is the Swedish word for strength, which is an outstanding quality of these papers. They get their strength when the pulp is cooked in a sulphate solution. The major uses of these papers are in wrapping. Paper bags, all kinds of wrapping, and cardboard boxes are made from them.

The use of paper isn't limited, though, since it can be given almost any desired property through proper techniques in processing. Usually, paper is thought of as a substance which will burn rather easily, wrinkle permanently if crinkled up, and fall apart when wet. However, any

The complete picture of papermaking: Gather logs and slice them into chips. Cook the chips into pulp. Clean and refine the pulp. Make the pulp into a sheet of paper, which is finished, trimmed, packaged and delivered.
—Oregon Pulp and Paper Co.





—St. Croix Paper Co.—AFPI Photo

A workman adjusts the flow of pulp onto the Fourdrinier. Here this pulp consists of 99 percent water, most of which must be removed through the wire mesh of this machine.

of these properties can be changed with the addition of various chemicals in the manufacturing process.

Special Uses of Paper

Wrinkle-proof papers have been developed and are used for various products such as inexpensive paper curtains.

Flameproof paper finds very wide application. It is used to camouflage guns which develop heat that would set ordinary paper on fire. It is used to make wallpaper, paper draperies and paper building board. In fact some ashtrays are even made out of this specially treated paper.

During the second world war the paper industry developed a "wet strength" paper. This was a strong paper which did not lose its strength when wet. It was to be used as a base for printed matter which was to be exposed to water and physical strain, such as maps used on the front lines. When first presented with the paper the Army put it to the following test:

They soaked it in water and wrung it out 20 times. They folded and unfolded it several times and then pounded it with rifle butts. Then it was trodden into mud, smeared with grease, doused in gasoline and boiled in soapy water. Next it was fastened to a floor while a regiment marched over it, and finally, it was subjected to a drubbing under tank treads. This amazing paper emerged hardly any the worse for its wear.

Aside from its tremendous military application, this "wet strength" paper has had continually expanding civilian application. It has replaced burlap bags for shipping food products from the farm. It is used as a waterproof wrapping and for paper raincoats. It is being used in place of rags in many applications, such as for wiping windshields in gas stations. It has even been used as a waterproof cigarette paper.

Extremely strong papers which can be used for walls of houses and airplane wings are also made. These papers have a tensile strength of from 28,000 to 35,000 pounds per square inch. They are made by impregnating the paper with sulphur and then laminating it. This lamination process consists of gluing together pieces of the treated paper with the grain running in different directions in each layer, similar to the construction of plywood.

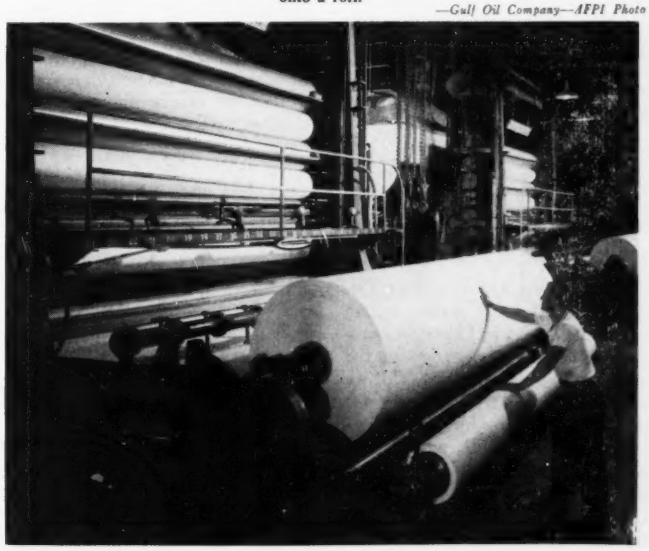
Paper has also been used as a source of pipes for electrical conduit and for water and sewage. It has special application in chemical plants where the chemicals attack ordinary metal pipes.

Extensive use of paper is found in the electrical industry. Here it is widely used as a dielectric material for capacitors and as an insulator for wires. It has the highest dielectric constant of any inexpensive insulator.

Impregnated papers also find wide application. Some wallpapers are impregnated with DDT to get rid of flies in homes. Wrapping papers processed with DDT are used

A workman checks paper for imperfections as it leaves the calender and is wound onto a roll.

—Gulf Oil Company—AFPI Photo



for wrapping and storing blankets and other woolen goods. Scented writing papers are made embodying perfume.

Plastic coated papers also find a large field of application as shelf coverings and as washable, grease resistant wallpapers.

Magnetically treated paper tapes are used for recording purposes. These recording tapes cost only one-third as much as wire tapes and are very durable. The recorded material can be played back 1,000 times without appreciable wear, or can be erased and new recordings made on the same tape.

Scientists in the paper industry are constantly working to find new applications of paper and ways to substitute it for other more expensive materials. The United States used less than 50 pounds of paper per person twenty-five years ago. Now it uses almost 400 pounds per person annually, and in the future will probably use a great deal more. Thus, although the development of paper lagged for most of its 2,000 year existence, the paper industry recently has been expanding at a very rapid rate and will probably continue to do so for many years to come.

—Rising Paper Co.

This interior view of a paper mill shows the production line of paper manufacture. In the foreground is the Fourdrinier, onto which the wet pulp flows; further back are the drying rolls, and then the calender rolls (out of sight), off which the finished paper comes.

Letters to the Editor

To the Editor:

The problem in division in your December issue is interesting, especially as it began to develop into a '97 quotient and I am a '97 man.

I find divisors from 113 to 124 inclusive and for all of them the same quotient, 97890.

Yours truly,

G. F. DeWein
Milwaukee, Wis.

To the Editor:

The problem given in your December issue of any perfect square whose digits add to 15 can be readily resolved by application of the method of casting out nines. If we take all the integers from one through nine (to which any number can be resolved), the squares will result in the following remainders (nines removed): 1 (twice), 4 (twice), 7 (twice), 9 (three times). Therefore, we will find no perfect squares with other than the preceding results, eliminating 15 as a possibility (nine removed leaves six, which is not in the foregoing list), also eliminating 11, 12, 14, 17 and 20, taking the series 10 through 20 as an example. The method of course applies to any number.

Very truly yours,

Oliver S. Johnson, E.E. '34
Little Silver, N. J.

To the Editor:

Re: problems in December issue.

Solution to the question sent in by George W. Lord:

There is no perfect square, the sum of whose digits is 15.

The sum of the digits in a perfect square is equal to the sum of the digits in the square of the sum of the digits in the original number.

i.e. if $(ABC)^2 = (DEFGH)$

then the sum of the digits in

$(A+B+C)^2 =$
$(D+E+F+G+H)$

in numbers this would be:

$12^2 = 144$
$(1+2)^2=1+4+4$
$3^2 = 9$
or $52^2=2704$
$(5+2)^2=2+7+4$
7^2 or $4+9=13$
$4 = 4$

There is no number that, when A+B+C is squared, will give a number the sum of whose digits is 15.

To John Fish's long-division problem there are several answers, two of which have divisors of 113 and 114 with a quotient of 97890.

Yours truly,

John Pierce, ME '57
Ithaca, N. Y.

See January issue for George W. Lord's solution.

The Present Status of Color Television

By ROBERT E. FLORY, EE '54

Illustrations courtesy R.C.A.

In October, 1950, the Federal Communications Commission approved the "CBS system" of color television for use in this country in prefence to a system proposed by RCA and others. American television broadcasters and manufacturers, with the exception of CBS interests, opposed this decision. How the FCC could make a decision which did not satisfy the overwhelming majority of the firms in the television industry was a puzzle to the public. Sales of television receivers dropped after the FCC announcement, reflecting public apprehension about the future of television.

In order to understand the reason for the FCC decision and its opposition by the television industry, we must first understand black and white or monochrome television technique and the basic operation of both the CBS and RCA systems of color television.

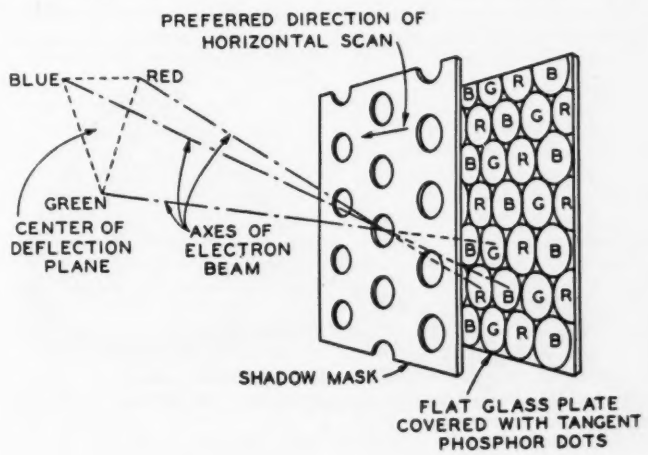
Monochrome Television

In monochrome television, as in motion pictures, the illusion of motion is obtained by showing a large number of static pictures in rapid succession. In standard motion picture practice 24 pictures or frames are shown per second and in American monochrome television, 30 are used. In television, the deception is carried still further. Instead of showing a whole frame at a time, each frame is broken down into 525 horizontal lines. These lines are formed by an electron beam which sweeps rapidly across the face of the picture tube, while moving slowly in a vertical direction. Thus, there is never a complete picture on the screen, only a spot resulting from the collision of the electron beam with the sensitive coating on the face of the tube.

The intensity of the electron beam and consequently of the spot of light varies as the beam scans areas of unequal brightness in the televised object. The persistence of the human eye makes the viewer think there is a complete, moving picture on the screen. Thus a television image is sent by dissecting the picture and sending each bit of brightness information, converted to electrical impulses, in a predetermined sequence over a wire or radio communication system. This sequentially transmitted information is reconverted to a light image by a process the inverse of that at the transmitter.

To add color to television, a way must be found to add color information to the monochrome brightness signal of a regular television transmitter. The easiest and most direct way to do this is to send three brightness signals, one for each of three primary colors. This is the way color pictures are reproduced in magazines. The same could be done with three television stations, each transmitting one of the primary color signals. This is, of course, impractical because of the lack of space in the radio spectrum. In the CBS system, this problem is solved by sending the color signals sequentially. This amounts to sending a frame of one primary color, followed by a frame of another primary, and so on, repreating each color every third frame. If the standard monochrome scanning rates are used, a complete color picture would be formed 10 times per second. This alternating color

Schematic diagram illustrating principle of the RCA shadow mask tri-color picture tube.



sensitivity can easily be obtained by the use of a disc consisting of red, green, and blue light filters. This disc is so placed that light must pass through the filters to get to the camera tube. The disc is rotated in such a fashion that the light filtering action is in synchronism with the scanning beam in the camera.

If the picture to be reproduced at the receiver is not too big, color reception can be accomplished by use of a similar filter disc in front of the picture tube, rotating in synchronism with the one in the camera. This filter disc presents a considerable mechanical problem as picture size increases. The disc necessary to get a color picture of six by eight inches is 22 inches in diameter and rotates at 1440 rpm. If monochrome scanning rates are used for frame sequential color, the flicker is objectionable. In the CBS frame sequential system the frame rate is increased from 30 to 72 frames per sec., giving 24 color pictures per second. Because the scanning rate is different from standard monochrome, CBS color broadcasts cannot be received on the 20 million monochrome receivers now in use, without costly modifications. Even if a receiver were converted to receive a color picture from the CBS transmitters, the results would be disappointing, because of the lack of detail in the picture.

Band-Width Restrictions

Another serious problem arises which is common to all color television systems. The FCC has restricted the band width for color television signals to the same width as that for monochrome signals, six megacycles. Whenever more information is added to a radio or television signal, the channel width required for the transmission of the signal must be increased. This is true in the case of frame sequential color television. If the channel width is restricted to six megacycles and color information is to be added to the monochrome signal, then some of the monochrome information must be sacrificed. The sacrifice made in the CBS system is to reduce the ability to reproduce fine detail. CBS color pictures are characterized by a lack of crispness, due to this lack of detail.

The frame sequential color system suffers from several color flicker and breakup effects. Large areas of solid color flicker excessively and rapidly moving objects change color as they move. Similar effects are obtained through movement of the observer's head or eyes. These effects were considered serious enough by motion picture engineers to force abandonment of frame sequential color motion pictures in the very early days of motion picture color development. For these same reasons, frame sequential color television was abandoned by RCA and others about ten years ago.

Despite these disadvantages, the CBS system looked more attractive to the FCC. The apparent simplicity of receivers and the excellent color rendition offset the above mentioned disadvantages, in the minds of the commissioners. However many engineers feel that the defects in the CBS system are too fundamental to be worked out. This fact was apparently overlooked by the FCC and because the RCA system had not been developed to the state of perfection of the CBS system in 1950, it is not surprising that the CBS system was adopted.

The present RCA system was only under development for two years when the FCC decision was made. On paper, the system had much to offer. There was no color breakup or flicker and monochrome receivers would receive high quality pictures from RCA color transmissions.

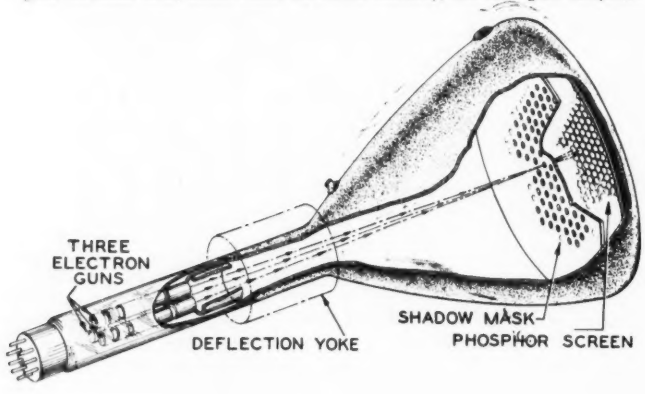
As demonstrated in 1950, RCA color television did live up to these claims, but pictures were dim and the equipment was bulky and expensive. However, in two years the system has improved to such an extent that it now is certainly the superior system.

Compatible System

Because of the strides taken in the development of the system, only the system as it stands now will be described. This represents the work of the National Television System Committee, a group composed of representatives of various manufacturers in the television field. The NTSC system (successor to RCA color) is the work of the television industry as a whole and in particular RCA, Philco, and the Hazeltine corporation should be mentioned.

In explaining the CBS system it was stated that to add color information to a monochrome television signal, while keeping the bandwidth constant, something must be thrown away. RCA engineers found that this was not necessarily true. It was found that the monochrome picture did not completely fill the allotted space. The situation may be compared to a glass jar full of marbles. The jar is "full" of marbles, but there is still room for sand between the marbles. The holes are found when the frequency makeup of the television signal is studied. It can be shown that monochrome signal components are bunched in groups at line frequency and at

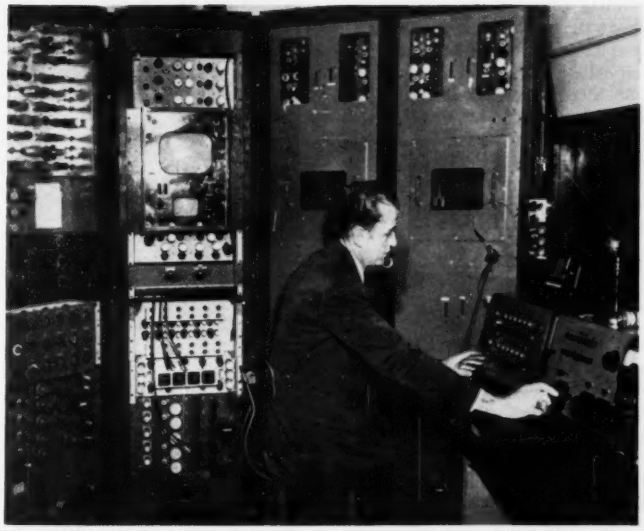
Cutaway view of the RCA tri-color picture tube. Parts from left to right are: Electron guns, deflection coils, shadow-mask dot screen assembly, and clear glass faceplate.



line frequency harmonics. Definite holes exist in the frequency spectrum between these signal frequencies. The problem then arises as to what information to put in these holes. Here a new approach to the problem of color specified is used. Color can be specified by being broken down into the three primary color components, as is done in the CBS system, or into brightness, hue, and saturation, as is done in the NTSC system. Brightness is self-explanatory. Hue is the quality which is called color by the laymen. Saturation is the term which describes the strength of a color. A 100% saturated red would be pure red. A low saturation red would be recognized as pink. Zero saturation red would be white. The NTSC system utilizes the monochrome signal as the brightness component while the hue and saturation information is put in the holes in the brightness signal frequency spectrum. To accomplish this, the hue and saturation information is put on a color subcarrier, and the subcarrier is placed in the high end of the brightness frequency spectrum. The proposed frequency for this subcarrier is 3.898125 megacycles. This carrier frequency is chosen so that all its sidebands fall in the holes in the brightness spectrum and do not appear as interference in the picture. Further reduction in visible interference is accomplished by suppressing the carrier and sending only the sidebands. The carrier is then reinserted at the receiver. As the brightness signal is transmitted with all of the detail intact, and scanning rates are the same as for monochrome television, a high quality monochrome picture will result when an NTSC signal is received on a standard unmodified monochrome receiver.

Test Results

In field tests of the NTSC system, it was found that monochrome reception of NTSC broadcasts were as good and many times better than the reception of monochrome broadcasts. Conversely, the NTSC color receiver will reproduce monochrome broadcasts as well as color broadcasts. Because of the reduced sensitivity of color cameras and the increased production costs of color programs, some monochrome programs will probably always be broadcast.



Pictured above is the control room for color televising equipment. In background are panels at which signals from color TV cameras on the studio floor are controlled and monitored before transmission.

It has been found that detail is "seen" in monochrome and that very little detail is needed in color. Consequently considerable saving in bandwidth can be accomplished by sending the hue and saturation information with limited detail, and putting the detail in the brightness signal.

In fact, the NTSC signal in four megacycles of actual picture signal gives as good results as a theoretical system of twelve megacycles. A well known technical writer, Donald G. Fink, has said that this is "the most striking accomplishment in spectrum conservation in the history of electrical communication."

When an NTSC broadcast is received on a color receiver, the information is decoded and combined in such a way as to give three signals for the three primary colors and one high resolution brightness signal. The nature of the NTSC system is such that the rotating disc presentation of the color picture cannot be used. Early RCA receivers used three separate picture tubes, one for each primary color, the images being combined by means of mirrors. This type of viewer is too bulky and expensive for home use.

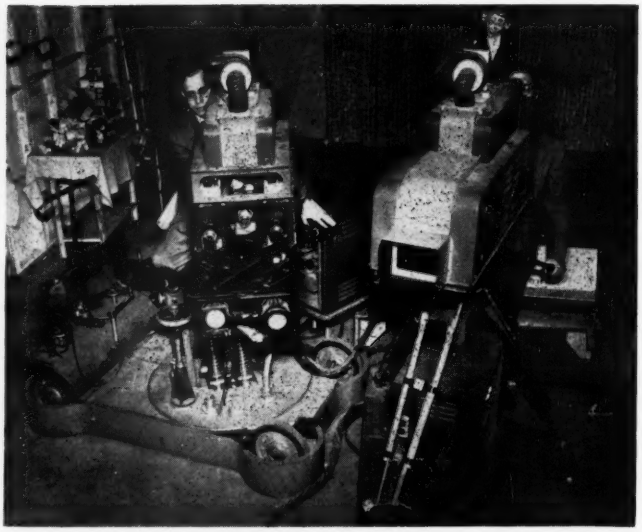
Early in 1950 a tricolor picture tube was announced by RCA. Although many color tubes have been proposed before and after the RCA tube was announced, none of them have proved to be as workable. The RCA tricolor tube presents a full color picture on its face without the use of lenses, mirrors, filters, or any sort of moving parts. Instead of using a screen coated with a material which emits white light when struck by an electron beam, as in monochrome picture tubes, a color dot screen is used in the tricolor tube. This screen consists of about 200,000 groups of dots, each group containing one red, green, and blue dot in the form of tangent circles. The dots glow in these colors when struck by the electron beam. Behind the dot screen is a shadow mask. This mask is a sheet of metal having one hole in it for each phosphor dot group on the dot screen. Each hole is accurately aligned behind a dot group. Several feet in back of the screen-mask assembly is located the electron gun assembly. Instead of one gun located directly on the axis of the tube (as in monochrome picture tubes) there are three guns, one for each of the phosphor colors. Each gun is so positioned that when its beam passes through the shadow mask, it can hit phosphor dots of one color only. Thus each gun has control of the

primary colors of the tricolor tube. When the common brightness signal is applied to all guns and the different color signals are applied to each gun, a color picture will result. The dots of color are so small and so close together that they are not visable in the picture. Pictures composed of color dots in groups are to be seen every day in magazines.

Tube Production

The tube can be made in any of the picture sizes now in use. Most of the tubes built have been of the 16 and 21 inch sizes. The problem of accurately aligning the phosphor screen and the shadow mask is not an impossible one. Techniques of photography and silk screen printing are being employed and there appears to be nothing fundamental which prohibits the fabrication of these parts on a large scale. Mass production techniques are being tried out in pilot production facilities at RCA, and other manufacturers are working on the problem using information supplied by RCA.

In June, 1951, tricolor tubes and special circuit components were given to 230 licensees of RCA, television receiver and tube manufacturers, to help speed the development of color television receivers. A Westinghouse receiver, described in the January, 1953, issue of *Electronics,* uses 42 tubes as compared to 24 tubes used in a monochrome receiver of comparable size. It is expected that this number can be reduced in the future. Monochrome receivers of eight years ago with comparable picture size used about 45 tubes. Today's monochrome receiver performs better in every respect. There is every reason to expect a similar change in color receivers.



RCA color TV cameras as used in the first developed dot-sequential system. Cover of left camera has been removed to show dichromic mirrors and reflectors which split the light beam into three primary colors.

Color broadcasts originating from NBC in New York and Washington have been utilized by RCA and other manufacturers to evaluate their experimental receivers. Experience gained from the design and testing of such experimental receivers is paving the way for receivers suitable for mass production and dependable operation in the home.

The question arises, when will we have color television in the home? This is a difficult question to answer. First the NTSC system will have to be approved by the FCC for commercial use. This step may take several years. By the time the FCC gives the NTSC system its approval, manufacturers will probably be in a position to supply a limited quantity of receivers to the public. Prices will be relatively high at first; $500 would not be unreasonable for a 21-inch console receiver. Broadcasters will be in a similar position, being able to offer some color programs as soon as FCC approval is given.

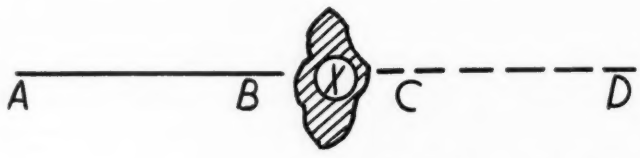
Summary

The CBS frame sequential system, while offering certain advantages of simplicity, has fundamental limitations which prevent any future elimination of its obvious defects. The RCA or NTSC system offers color television which is acceptable in its present form and leaves future room for improvement without obsolescence of the standards. Some equipment will probably be available immediately after the FCC approval is given to the NTSC system.

This Month's Brain Teaser

1. Straight line A-B is drawn.
2. At the end of A-B, its extension is blocked by "forbidden area" X.
3. A straight edge may not be placed across X.
4. The only tools available are a pencil and a straight edge. The straight edge is not calibrated, and no marks may be made upon it.
5. Construct an accurate extension of A-B (shown as C-D) without violating the forbidden area and only by ruling along one side of the straight edge.

Submitted by J. W. Paddon, '28, *Washington, D. C.*



Faculty Profile

Professor John R. Moynihan

By WILLIAM H. BENTLEY, EP '54

In the old "mech lab" building to the north of Sibley was once the office of Professor John R. Moynihan of the Department of Engineering Mechanics and Materials. In the halls of the "mech lab," trod upon by generations of Cornellians, there have been signs of unaccustomed activity. The Department of Engineering Mechanics and Materials is in the process of moving to its new home, Thurston Hall, which is now the permanent and official GHQ of the department.

This is but one of the many milestones in Cornell engineering that Professor Moynihan has seen. A native of Buffalo, New York, Professor Moynihan graduated from the Sibley School of Mechanical Engineering in 1926. After three years away from "those good old days on the hill," he decided to return to Cornell for graduate work. Professor Moynihan has been associated with the University continuously since that time. He originally joined the faculty of the Sibley School of Mechanical Engineering. In 1942, he became a part of the mechanics and materials section of the mechanical engineering school. An integration of similar sections was effected in 1948, and the present Department of Engineering Mechanics and Materials was formed under the leadership of Dr. Dwight F. Gunder, who is presently the chairman of the department.

Both as an undergraduate and as a member of the faculty, Professor Moynihan has been engaged in the activities of the University. He was a member of Cornell's basketball team during his undergraduate years, and following his return to the campus he was assistant basketball coach until 1936. In another continuation of his undergraduate life, Professor Moynihan is the alumni counsellor for Pi Kappa Alpha Fraternity, in which he was active as an undergraduate. At the present time, he is the baseball faculty advisor. Professor Moynihan is a member of both the Engineering College and the University Policy Committees and is secretary of the latter. Before the last war, Professor Moynihan was also associated with the Placement Department.

During the war, Cornell was operating a training program outside the university for the rapidly expanding war industry. Professor Moynihan was active in this program of extramural training, which was being carried on in his home city at the University of Buffalo.

In addition to this work directly connected with the official organization of the University, he is a member of many professional societies. Some of these are: Tau Beta Pi, Sigma Xi, Phi Kappa Phi, Atmos, and the American Society for Metals, for which he is the southern tier's vice-chairman.

Besides his rigorous schedule of teaching and general activity about the campus, Professor Moynihan is working on two major research projects. He and Professor Conway of the same department are jointly studying the effect of shock waves in metallic materials. Several reports have already been written by them pertaining to the impact or shock loading of beams. This particular project is being sponsored by Johns Hopkins University. The other research Professor Moynihan is doing is called "Project Lincoln" and is being carried out through the Massachusetts Institute of Technology. As can be guessed from the title, it is highly classified for security, but the professor dropped a small hint that it was in some way connected with rocket studies.

Professor Moynihan is married and has a daughter who is a junior in the College of Arts and Sciences. Even though he is busy within the University, off the campus he still has some time for his own hobbies and interests. Professor Moynihan says that in the summer he is interested in sailing and golf, and in the winter he waits for summer.

From the beginning of his freshman year as an undergraduate to the present time Professor Moynihan has been a part of the Cornell tradition and as a member of the faculty has contributed greatly to the activities of his own Alma Mater.

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"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish closer relationship between the college and the alumni."

The time has come for American business and industry to recognize more fully their dependence on the benefits derived from colleges and universities. These institutions have been the fundamental source of trained men and new knowledge. These are basic resources in our economy. They have been fully used with far too little consideration concerning their continued supply and quality.

The owners and managers of American business and industry have been very vigilant in plowing back a portion of earnings into their enterprises so as to survive, grow, and prosper. Little, however, has been reinvested in colleges and universities to assure continuance of their benefits to enterprise. Some much needed funds have been appropriated for research, scholarships, fellowships, and the like. This type of investment must be continued and expanded. Of equal, or perhaps more importance, however, is the need of privately endowed colleges and universities for unrestricted funds to maintain and improve the quality of the teaching staffs and the adequacy of their equipment. Means must be found to raise academic salaries which, since 1939, have not remained in step with the economy. During this period such salaries have only increased an average of 60 to 65%, whereas consumer prices have increased 85 to 90%. This compares with an average increase of about 150% in the pay for hourly workers in manufacturing. In view of this increasing financial sacrifice, some of the best teaching talent is being forced into business and industry. This trend, if continued, can only result in poorer trained graduates.

Cornell alumni should be informed of an important step taken last Fall by the University, involving the formation of an organization known as the Cornell University Associates. This organization offers business and industry a medium through which they can invest in Cornell and, at the same time, realize immediate and tangible benefits themselves. Few universities have equal diversification of teaching and study where business and industry can find fields of mutual interest. Services available to members of the Associates are as follows:

a. Discussion and consultation
b. Conferences and seminars
c. Publications
d. Library facilities
e. University placement service
f. Reservations and accommodations
g. Other services to be developed through mutual interest.

Membership in the Associates may be applied for by any acceptable business, commercial enterprise, or financial or industrial organization, incorporated or unincorporated. The minimum membership fee is $1,000 per year. Larger organizations may find it most effective to take out several departmental memberships.

I feel that members of our Society should be aware of this organization so that they will be in a position to educate owners, stockholders, directors, and managers of business on this possibility for investment. Further information on this and other methods for investing in Cornell may be obtained from the University Development Office at Ithaca. Cornell has an enviable record in pioneering new fields of education and educational methods. In addition, it has contributed many important scientific and technical advancements as well as having developed further understanding of the humanities and social sciences. This type of investment will provide very attractive returns. It must be recognized for what it is, namely, a basic part of the responsibility of business and industry.

K. J. NELSON

ALUMNI NEWS

Stewart McDonald, M.E. '99, is continuing as chairman of the board of Maryland Casualty Company, as well as chairman of the executive committee of the Baltimore and Ohio Railroad. He now lives at "Cherrywood" in Locust Valley, Long Island.

Frederick B. Wufnagle, M.E. '99, has been elected a director of Beryllium Corp. and of its subsidiary, Beryllium Development, Inc. He was formerly president and board chairman of Crucible Steel Co. of America. He lives on Dingletown Road, Greenwich, Conn.

Charles C. Remsen, M.E. '00, assistant to the president of Diehl Manufacturing Co., Somerville, N. J., received a fifty-year certificate of recognition from the National

Charles C. Remsen

Electrical Manufacturers Association. He started work with the Sprague Electric Co. and in 1908 became district manager of Diehl Manufacturing Co. From 1932-1933, he was a member of the NEMA board of governors.

Gustavus A. Kositzky, M.E. '05 of 12717 Road, Cleveland Heights 6, Ohio, is a consultant for the Brazilian Telephone Co., Rio de Janeiro, Brazil.

Ethan F. Ball, C.E. '14, attended an October meeting of the Student chapter of the American Society of Civil Engineers in Ithaca, where he discussed the erection of the forty - one - million - dollar Chesapeake Bay Bridge, which he supervised. His home address is 1971 Homestead Avenue, Bethlehem, Pa.

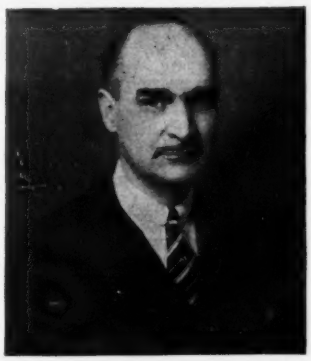
Arthur Edward LaCroix, C.E. '16, executive vice-president of New England Power Co., died Sept. 5, at his home, 130 Old Colony Road, Weston, Mass. He had three sons who graduated from Cornell: Robert '42, Arthur J. '43, and Dr. George E. LaCroix '45.

Carl W. Badenhausen, M.E. '17, is the new President of the New Jersey Brewers Association. He is also president of P. Ballantine and Sons, Newark, New Jersey.

John G. Oun, M.E. '24, has been appointed superintendent of steel conservation and quality control for the Warren, Ohio, district of Republic Steel Corp. John has been with the company 22 years. He was born in Tokyo, Japan, and was graduated from high school in that city. He attended Cornell and later studied metallurgy for two years at Carnegie Institute of Technology.

Frank H. McCormick, M.E. '10, who did much of the exploratory work which led to the entry of the Du Pont Co. into the manufacture of motion picture film, recently retired from that organization after thirty-six years of mixed service. Most of his work had been in technical research, but with time out for promotion on various products in whose early development in the laboratory he had participated, notably the motion picture film and special wood pulps for use in the chemical industry.

McCormick's talents have also been employed in less technical and broader fields, notably in the creation of Wawaset Park, a tremendous project his company was obliged to go into at Wilmington in Warld War I to take care of its expanding personnel. He served as the company's representative in that enterprise, helping to select



Frank H. McCormick

the site, supervise the planning and construction of the dwellings, and afterwards their sale to employees at cost. And after a new company was formed to take over the project from the DuPonts, McCormick remained in it as a director to take an active part in the Park's development.

Dexter S. Kimball, Jr., M.E. '27, M.M.E. '28, was promoted to general manager of Bendix-Westinghouse Automotive Air Brake Co. He and Mrs. Kimball and their two sons reside at 668 Washington Ave., Elyria, Ohio.

Jesse A. Jackson, M.E. '28, of the St. Regis-Kraft Corp., Jacksonville, Florida, became chief design engineer for the company when operations began in the Eastport, Florida, division of the mills in December. At the October Meeting in Chicago of the Technical Association of the Pulp and Paper Industry, he presented a paper on engineering research and machine design. Mr.

and Mrs. Jackson and their three children live at 5821 Dickson Road, Arlington, Fla.

Charles E. Eeles, M.E. '29, is the new vice-chairman of the industrial and commercial gas section of the American Gas Association. He was elected October 30 at the Association convention in Atlantic City, N.J. His address is 2314 Orchard Rd., Toledo, Ohio.

Irving Taylor, M.E. '34, is in his thirtieth year with Lummus Company, New York City. He is head of the pump and compressor section in the engineering department. He and Mrs. Taylor live at 437 Melbourne Avenue, Mamaroneck.

Alfred Crew, C.E. '36, opened an office as consulting engineer at 45 North Broad Street, Ridgewood, N.J., November 1.

Robert G. Irish, B.S. in A.E. '40, has been promoted to patent counsel in the component products division and motor and generator division of General Electric Company. His address is 1504 Barclay Place, Schenectady 9.

H. A. Berger, M.E. '41, works in the special research projects department of the Chrysler Corp. engineering division. His new address is 13220 Woodward Avenue, Highland Park, Mich.

Lt. Commander Henry J. L. Rechen, C.E. '41, santiary engineer, US Public Health Service, of North Branch, N.J., was assigned, October 15, to the New Jersey State Department of Health as a radiation specialist in the Bureau of Industrial & Adult Health.

Norman Barrett, B.S. in A.E. '42, reports his return to Shell Oil Co. as construction and maintenance supervisor of the Washington District after a twenty-one month tour in the USAF from the Pentagon to Korea. He and Mrs. Barrett live in Falls Church, Va.

James M. Goodwillie, M.E. '42, lives at 2590 Bonnie Drive, cincinnati 30, Ohio. He is with the building materials division of Armstrong Cork Co.

Joseph E. Jewett, Jr., B.Ch.E. '47, a contract engineer with Foster-Wheeler, Ltd. of England, on an oil refinery project for an Australian client. His present address is 96 Chatsworth Court, Pembroke Road, London, W8. He asks: "Anybody want a companion and automobile transportation for two weeks in France, Germany, Austria and Italy next summer?

William C. Arthur, B.S. in A.E. '48, engineer in the abrasives and bond division of Norton Co., has been elected to the board of directors of the Worchester Chapter, Society for Advancement of Management. His home is at 26 Brattle Street, Worchester, Mass.

Walter J. Hickey, B.C.E. '49, 35 Upland Rd., Quincy, Mass., has begun a new job with Turner Construction Company in Boston.

Jack Spergel, B.E.E. '49, is an electrical engineer at the Signal Corps Engineering Laboratory, Fort Monmouth, N. J. He and his bride, the former Helen B. Levine, live at 412 Third Avenue, Asbury Park, N.J.

Lieutenant (j.g.) Donald A. Weiss, B.M.E. '49, is attending a year's course in guided missiles for Army-Navy officers at AA & Gm Br, TAS, Box 1630, Fort Bliss, Tex.

Robert Ellis, M.E. '50, is production manager in the Aero Division of H. M. Harper Co., Morton Grove, Ill. He and his family live at 332 South Newbury Place, Arlington Heights, Ill.

Howard Hart, E.P. '52, is with DuPont's polychemical research division at Wilmington; he was formerly with the Oak Ridge National Laboratory.

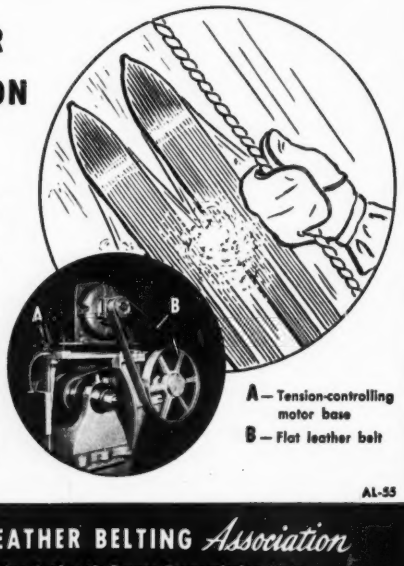
FOR THE LONG PULL...

IT'S LEATHER PLUS TENSION CONTROL

On the ski tow it's the leather grip of your ski mittens plus tension controlled by your hands that helps you get the most out of power.

In modern industry, the UNI-PULL short center drive uses leather belting and tension control for long, trouble-free power transmission.

That's part of the reason why today there are more leather belt drives in industry than ever before.



A — Tension-controlling motor base

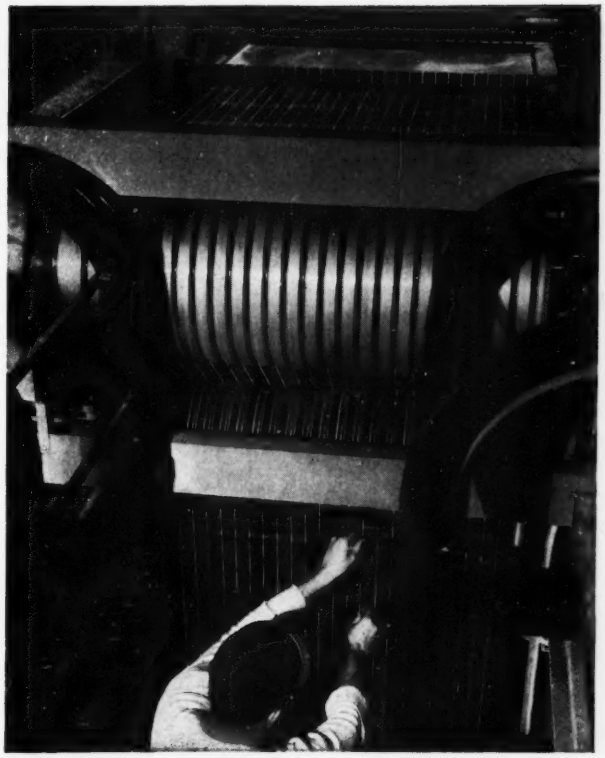
B — Flat leather belt

AL-55

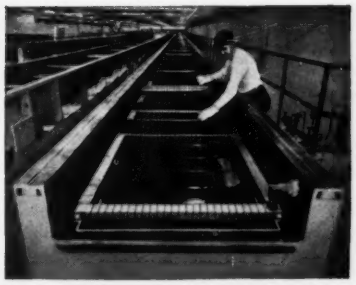
American LEATHER BELTING Association

Headquarters for Authentic Power Transmission Data

320 Broadway, New York 7, N. Y.



25 strands of steel wire start on their way to be electrolytically coated with copper, lead and brass.



Part of the 600 foot long electroforming machines where wires go through successive baths of plating solutions.

Console of controls for entire process is readily operated when necessary, even though seldom used in the almost fully automatic operation.

ENGINEERING . . . with a pioneering twist

There's a real incentive in working out ways to do things that have never been done before. And problems in pioneering are constantly cropping up at Western Electric—manufacturing unit of the Bell Telephone System.

For example: the revolutionary electroforming process dreamed up and made a reality by Western Electric engineers for making copper coated steel wire.

The big idea was this: Could a process be developed in which successive coats of copper, lead and brass would be deposited on steel wire electrolytically in one continuous operation?

Engineers of varied skills—electrical, mechanical, chemical, metallurgical, civil—went to work as a team. After solving many problems, they came up with a process that makes better, stronger wire at lower cost—does it at the rate of 1¾ billion feet per year.

Recent developments such as microwave radio relay networks for telephone calls and television programs—operator and customer dialing of long distance calls—secret electronic equipment for the Armed Forces—promise an ever-widening field for young engineers of varied training at Western Electric.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Soil Testing —

Yardstick for Construction

By M. D. MORRIS, C.E. '44
and JOHN P. GNAEDINGER, M.C.E. '46

Illustrations courtesy Soil Testing Service, Inc.

(In the next issue the authors will follow this general discussion with applications to specific engineering problems.)

Everyone is familiar with the cracked plaster and leaky basements that follow poor residential construction. Less common, but more spectacular examples are leaning towers; dams that do not hold water; tipping grain storage bins; and bridges that wash away. There is no man-made structure of a permanent nature which is not entirely dependent, for support, upon its underlying soil and rock. Ergo, the subsurface can be considered part of the structure itself, and the characteristics of this member must be known before a rational design of the rest of the structure is possible.

Predictions of the behavior of the underlying deposits are made from the experienced evaluation of exploratory and testing results. These include determinations of strength, slippage, susceptibility to volume change, and the degree of resistance to the flow of water, all of which influence the final design. Failure to study foundation conditions adequately before construction represents a definite gamble in which the chances are with the gamble, but unfortunately in which, to the loser, the stakes are entirely too high. In nearly every case, early foundation exploration will diagnose the problems in advance and insure satisfactory performance of the structure.

Once the primary phase of a construction program, the site survey (which furnishes location, elevation and general surface characteristics), is completed, a preliminary subsurface investigation can proceed to determine general conditions. There is no set pattern for this work. Flexibility is necessary as each individual project requires a specialized program, determined by the type and size of the project, and the available data from other sources. In addition, the field sampling routine depends upon the type of tests planned to be made in the laboratory.

A well devised exploratory program will study topography and geology in order to judge the nature and cost of the detailed study. Aids to this are found in nearby construction projects, old well drilling logs, or geological profiles.

Exploratory Program

The information required from the detailed study differs in extent and exactness with the building to be performed later. The site for an average two story residence, for example, can be investigated by two small diameter, shallow drill holes which will find the ground water level and the character of the upper strata. On the other hand, samples

ABOUT MR. GNAEDINGER

John P. Gnaedinger received his B.C.E. from Cornell in 1946, and Master of Science Degree the following year from the Northwestern Technological Institute. During the three years following his graduation from Cornell, he worked for Shaw Metz & Dolio in Chicago.

With the partnership papers signed early in 1948, Mr. Gnaedinger joined with a classmate from Northwestern in forming Soil Testing Services, whose purpose was to offer a service to the building industry by making soil investigations for foundations, and to manufacture equipment for performing engineering tests on soils.

The firm was incorporated in 1949 and the personnel expanded to about 35 in 1952. Testing equipment sales have expanded into a world market, and soil investigations have been made throughout the country.

Mr. Gnaedinger is President of the Soil Testing Services, Inc., and an executive of several other businesses. He has been active in the ASCE, ASTM, Western Society of Engineers and other professional societies, and is currently Secretary of the Illinois Section of the American Society of Civil Engineers.

John P. Gnaedinger

A sketch of Mr. Morris will appear next month.

Split tube sampler as used in soils investigations.

of material which is to support a bridge pier must be obtained continuously to considerable depths in order to learn the strength, compressibility, particle size and chemical properties of all soil and rock encountered. The results of such borings are conventionally shown as a graphic log indicating the location, depth, and composition of each stratum sampled. Also shown are ground water table and bedrock surface, if either were contacted. Chemical analysis of soils samples is of importance in the extent of pH determinations. Soils with pH values in the acidic range will have corrosive action on steel piles and sheeting driven therein. The economic advantages of being able to coat these members protectively before driving need no elaboration. Conversely, the assurance that a particular soil has an alkaline pH value would preclude the needless expense of blindly coating all steel to be buried.

The choice of a foundation type is a function of both the superstructure and the subsurface adequacy. Much time and effort in precision is expended in computing the overall structural design; yet the foundations are generally done by rule of thumb. If for any reason doubt exists—a higher order of foundation is automatically the next move. This groping in the dark is never the case with superstructure design; why then, should the support of the project be a hit-or-miss proposition?

It can be proved conclusively that in all cases where investment was made for subsurface investigation definite savings resulted. In locations where the soils were previously unknown, economy was affected by the assured reduction in design and consequently in construction costs for the smaller foundations which were all that were shown to be necessary. The saving in time, labor, and materials in such cases has been greater than the cost of the entire exploratory program. In cases where prior experience with soils in the neighborhood formed the basis for design, the expense of post-construction shoring and underpinning were saved by revising and enlarging the foundation (or even the entire structure) as a result of specific site soil studies. Where the design was made subsequent to testing, or where affirmed the correctness of the footings selected, the confidence in—and absence of concern about—this part of the work is substantial return for the fractionally small outlay. There is no substitute for the efficient manner in which a design engineer can proceed when he has all the pertinent data on hand at the outset.

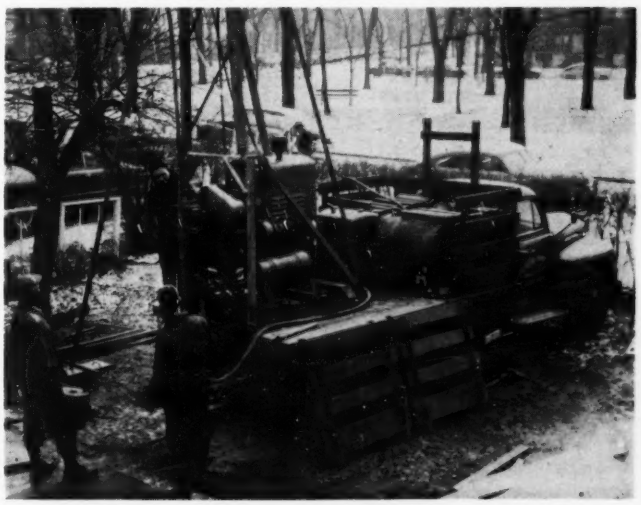
Evaluation of Data

Evaluation of field data to form final recommendations often necessitates assumptions where facts cannot be found or cannot be relied upon. As knowledege of soil characteristics increases, the number and magnitude of such assumptions are reduced. As foundation exploration becomes more all inclusive, and consequently more complex, those associated with these problems become less artistic and more scientific.

Practically, by knowing what soil conditions exist under a job, a contractor can exercise more exactness in his selection of types and sizes of earth moving equipment; in his choice of construction methods (reflected in the use of well-points or special piling, etc.); and in his quotation for materials costs and haulage expense. The presence, or absence, of construction materials and aggregate in the vicinity; volumes, extent and suitibility, and proximity to the jobsite are all determined by a soils survey. All this advance knowledge lowers the bid price to the owner and the risk to himself without jeopardizing in any way the safety of the finished product.

No mention has yet been made concerning the value of a site soils investigation as a preventer of many legal actions by eliminating the pitfalls leading thereto, or the

Soil drilling rig making borings to 100 feet for an apartment project.



admission of boring logs as conclusive evidence for one side or the other in differences of opinion.

Need For Flexibility

To satisfy the myriad of specific demands, the engineering science of soil mechanics must be entirely flexible in techniques and modus operendi, but completely rigid in establishment of standards, evaluation of results, and comparison of these with each other and with the standards. Part II of this article will go into case histories and specific details of field sampling and testing, and laboratory testing and computation. For now suffice it to say that field sampling may be accomplished from a man-sized hand-dug open pit. In recent years this method has evolved to the use of drills which sink comparatively small diameter holes to great depths and remove practically undisturbed samples, a process requiring skilled drillers and not merely pipe pushers. Finally, soil strata may be investigated by recording the amount and degree of resistance to the passage of an electric current. Field testing may encompass basic, but accurate findings; but for final overall completeness, the laboratory with its consolidation, bearing ratio, and triaxial devices is the ultimate word in foundation determinations.

The engineering analysis of subsurface problems presents a technical challenge to the field of Civil Engineering. Foundation exploration is becoming more a familiar and valued portion of all construction programs; however, the vital need for this most important phase has to date impressed only a minority of engineers, architects, contractors and insurance investors. The encouraging note is that more key construction persons are becoming aware of the undesirable position in which a foundation gamble places them, and the minority is slowly becoming a majority. Through soil mechanics, some day the doubt will be entirely removed from the foundations of structures.

Why some foundations fail and others do not, and how prior experience in an area may help an engineer very little without confident knowledge of how to build his footings beyond doubt, were all discussed before in this article.

Now then, we shall confine ourself to a general discourse on subsurface exploration and its application to the design of foundations. It is not the intention of the authors to go into minute details that are more adequately described in standard texts from which transcription would be redundant. This discussion should be looked on as a general description of the topic, from which the reader may depart at any point to more specific references. The structures discussed

The triaxial apparatus as used in the laboratory.

are categorized as: single story plants, multi-story buildings, residences, bridges, highways, airports and dams. These are all general items with which we deal most in our daily work. They are treated in terms of typical foundation problems omiting such special instances as structures built on bedrock, water, or a six hundred foot stratum of volcanic clay.

Every foundation investigation must proceed to fit the needs of the ultimate structure and must be laid out to furnish the necessary information that leads to safe and economical construction. In the building of an airport, it is not generally important to know the shearing strength of deep strata, but only those near the surface. For building foundations, permeability of soils is not important, but for dams it is extremely so. Consolidation is not usually critical for a single-story plant structure, but it might be of prime consideration were a skyscraper planned. An investigation at considerable expense can be justified for a large factory worth $2,000,000, but cannot be reconciled for the same if a $10,000 home is planned, even if unit area loadings are identical. Undisturbed sampling methods are designed for obtaining information on the properties of soil in sites, and are of no practical value if the material sampled is to be used as borrow for a compacted fill when less expensive methods would suffice in the latter case.

Methods of Soil Sampling

It has been said earlier that there are three principal methods of taking samples from the soil for the purpose of determining physical (and chemical) properties viz.: sampling from a test pit, tube sampling in drill holes and auger sampling.

It has been recognized for years that wash samples, and any other methods which produce samples at a water content other than the natural water content, are worthless. Information obtained from boring of this type is useless and often misleading. And though seismic, resistivity and other general approaches to sub-surface reconnaissance are useful for certain correlative purposes, they cannot furnish quantitative data on the physical properties of the soil strata on which the structures are to be supported. It is important to have in mind at all times that seismic and resistivity methods will never replace the direct sampling of soils to determine the nature and extent of soil strata.

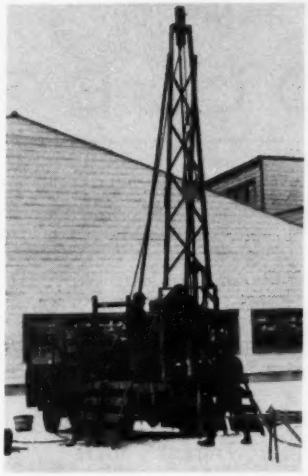
Test pit sampling is by far the most accurate method of sampling soils, though its cost is most times excessive, especially for deep pits. It is possible in test pits not only to see the soil at its natural moisture content, but also to observe the stratification in the soil. This information is often useful for correlating soil data from various portions of the structure. In this method of sampling, usually a cube sample approximately 12″ on a side is obtained by trimming around 5 sides of the cube, placing a box on top of the cube, and then digging beneath the cube to place the soil into the box. Paraffin is then added to preserve the natural moisture content of the soil. This method is fully described and specified in the American Society

for Testing Materials (ASTM) procedures for the Engineering Testing of Soils, 1944.

The most widely used and nearly perfect method of sampling is the one incorporating drilling equipment and thin walled or thick walled sample tubes. Here, a small diameter hole is drilled to the upper sampling elevation by rotary drilling equipment, chopping bits, or clean-out augers. Any method that provides a reasonably clean hole prior to the placing of the sampling tube at the bottom of the boring is satisfactory. Special precautions must, of course, be taken to keep the hole open by the use of drilling mud or casing. Under no circumstances should the casing precede the sampling in the drill hole. Moreover, where sand or silt is sampled special precautions must be taken to prevent a quick effect by permitting the water in the drill hole to drop below the local ground water table. After the drill hole is cleaned to the proper elevation, a sampling tube is inserted into the hole and either driven or pushed into the soil. The tube is either classified and placed in a jar at the job site; or the tube is hermetically sealed and shipped to a laboratory for further tests.

Methods Used

The two sampling methods most frequently used in the United States are the Shelby tube and the split spoon method. In the Shelby tube method, a thin walled tube with a diameter anywhere from 2″ to 5″ is pushed into the soil with continuous and rapid penetration. On removal to the surfaces, the ends of the tube are sealed with paraffin and the tube is shipped to a laboratory for testing. This method provides a reasonably undisturbed sample which has been found to be suitable for most engineering tests.



Borings being made to 50 feet in depth for use in determining soil sub-structure prior to building.

With the split spoon method, a thick walled steel tube is split, then rejoined by a coupling at each end, and driven into the soil by successive impacts from a hammer dropped a given distance. Penetration is obtained by means of the impact, and the number of blows is often useful in classifying the material sampled. Both these methods are described as to apparatus and procedure in "Suggested Method for Thin-Walled or Split-Tube Sampling of Soils" ASTM D-18-R2-Section B.

The Shelby tube method has been found most useful in sampling clays and silts, since the samples obtained can be shipped to a laboratory and tested to determine density for a silt and consistency for a clay.

Split spoon sampling is generally employed in sands and gravels to obtain a relative density of the material by counting the number of blows required to drive the sampling tube down one foot.

The use of auger equipment is subject to various serious difficulties. The samples obtained are never in an undisturbed state. It is impossible to auger through sand below the water table without the use of casing or drilling mud, thereby rendering the method often more expensive than the so-called undisturbed sampling method. Penetration through large gravel in boulder strata, and through hard pan and, of course, bedrock are almost impossible with auger equipment. Removal of samples from below the water table prevents reasonable identification of the material as it exists in its natural moisture content in the soil. Thus, because of these difficulties, auger samples are at best a poor substitute for tube samples, and are to be used only as the economics of the problem warrants. Probably the most important single place in which auger sampling is justified is in obtaining samples of borrow material for compactive fills. Here the natural state of the soil is not critical, and only the natural moisture content must be preserved.

(To be concluded next month)

NEWS OF THE COLLEGE

Cornell University has set up a special 5-year curriculum in agriculture engineering and will grant a new professional degree—bachelor of agricultural engineering—to students who successfully complete the new course.

A joint announcement of the new program was made by Dean W. I. Myers of the College of Agriculture and Dean S. C. Hollister of the College of Engineering, after approval by University Trustees. Several years of planning have gone into the development of the new course of study which will maintain the high standards required by both colleges, the Cornell Deans said.

The need for such a program is becoming more acute, and there are increasing requests for graduates in this field, according to the announcement. With mechanization of agriculture proceeding at a rapid pace, agricultural production problems are demanding more and more engineering knowledge and skill for their successful solution.

The Deans stated, "Crops and animal production, storage, processing, handling, and marketing all involve the application of engineering principles as well as a knowledge of agricultural sciences, including biology, animal nutrition, soils, field crops, and others.

"Design and development of new machines, service and maintenance problems, and efficiency in the use of equipment also come within the realm of the agricultural engineer."

The fields of opportunity, they noted, may well include teaching, research and extension in colleges and universities and government agencies, professional work with farm machinery manufacturers and dealers, food processing plants, commerical food storages, dairy industry plants, feed and fertilizer processing, or work dealing with the design and layout of farm structures, heating and ventilation problems, soil and water management, and other fields.

At present only one institution in the Northeast—Rutgers University—ofers a similar curriculum which has been accredited by the Engineers Council for Professional Development. Up to now Cornell has offered courses in agricultural engineering only for the general agricultural student and not for professional purposes.

Profs Present Papers

Three faculty members of the College of Engineering presented technical papers at the annual meeting of the American Society of Mechanical Engineers held in New York City. They were Prof. B. W. Saunders, whose paper dealt with production engineering; Prof. E. K. Henriksen, who spoke on metal-cutting; and Prof. Andre L. Jorissen. Other attending members of the faculty of the School of Mechanical Engineering were: Professors W. C. Andrae, D. G. Shephard, H. J. Loberg, R. M. Phelan, A. H. Burr, G. B. DuBois, A. F. Gagne Jr., F. W. Ocvirk and R. L. Wehe.

AIEE-IRE

A joint meeting of the American Institute of Electrical Engineers and the Institute of Radio Engineers was held in December. Members heard a talk by Mr. Carol Veronda of Sperry Gyroscope on the subject of Klystron Oscillators and Amplifiers.

ASME

The student branch of the American Society of Mechanical Engineers sponsored a discussion of "Computers, Their Use and Application" on December 18, 1952. Mr. Irving C. Ligget, director of the IBM Scientific Calculating Laboratory, was the speaker.

At a joint meeting with the Society of Automobile Engineers, ASME members viewed two films in December, "Little Henry" and "Report on Jet Propulsion."

CE Lecture

Dr. Charles H. Capen, president of the American Waterworks Association and chief engineer for the North Jersey District Water Supply Commission, spoke at Cornell, December 9. His discussion of "Waterworks Developments of the Past and Future" was sponsored by the Ithaca Society of Civil Engineers. Waterworks superintendents of communities in this area and the general public were invited.

Dr. Capen graduated from Cornell in 1917 and received an honorary doctor of engineering degree from the Newark College of Engineering last June.

He has received Cornell's Fuertes Graduate Medal, a Lincoln Arc Welding Award from the Lincoln Electric Co., and a George Warren Fuller Award from the American Waterworks Association. As vice-president and president of the association, he has visited nearly every section of the United States.

Society Tests Rocket

The Cornell Rocket Society is planning to complete a rocket-powered vehicle for vertical flight by the end of this spring term. This program in which the Project Committee is now engaged has been in progress since January, 1952, and consists of designing, constructing and proof-testing the components of the rocket system which includes, beside the liquid fuel propulsion system, a gyroscopically controlled servo mechanism stabilization system, and the airframe in which all components will be installed for the flight test. The prime purpose of the project is to offer to the engineering students a means of material application of classroom principles toward the working out from inception to completion a type of vehicle, whose far reaching effect is even today, far from fully realized. The first in the series of extensive

(*Continued on page* 28)

Your guardians of quality in radio, television and recorded music

When you see these trade marks on television sets, radios, "Victrola" phonographs, and other electronic instruments you are always assured the highest quality—born of leadership in research, fine engineering and craftsmanship.

The sun never sets on these trade marks, and millions of people around the world turn to them with confidence.

RCA, as the pioneer in the field, continues to lead in every major advance . . . in all phases of television.

RCA Victor has made radio a household word to millions of Americans. "Victrola" phonographs have extended great music from concert halls to homes everywhere, from Broadway to Every Street, U.S.A.

You also see these trade marks on records so rich in "living presence" that artists seem to be performing in your home.

Little Nipper and the familiar phrase "His Master's Voice" have appeared on recordings made by the world's greatest artists—for more than half a century.

These same high standards of quality make NBC the nation's leader in radio and television broadcasting. You can depend on RCA and RCA Victor trade marks as *guardians of quality*—sure guides to finer performance, dependability, better value and service.

Trade Marks ®

RCA *RADIO CORPORATION OF AMERICA*

World leader in radio—first in television

CONTINUE YOUR EDUCATION WITH PAY—AT RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

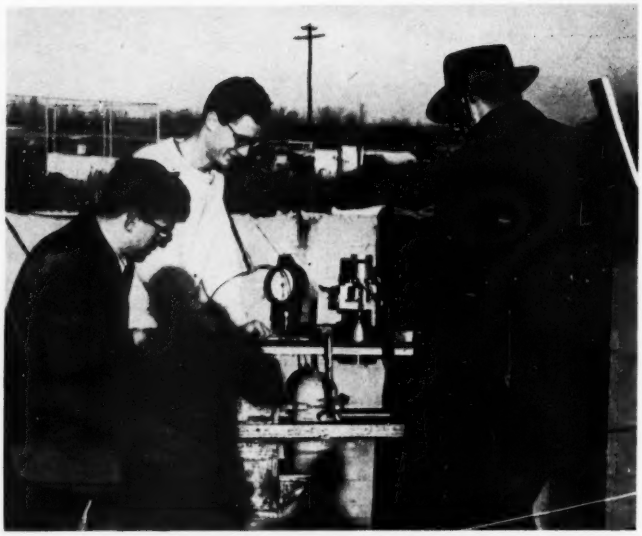
- Development and design of radio receivers (including broadcast, short-wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to College Relations Division, RCA Victor, Camden, New Jersey.
Also many opportunities for Mechanical and Chemical Engineers and Physicists.

College News

(*Continued from page 26*)

static motor firing tests was carried out at the Society's test station near Mohawk Airport on December 17, 1952, and although functionally inconclusive, it will make possible important improvements in the procedure and test set-up for the next test scheduled this February. In conjunction with a fifth-year Machine Design Project in the College of Mechanical Engineering, a new 200-pound thrust engine is now in the blueprint stage, and it is hoped firing tests may be resumed by early spring. Any students interested in joining the Society are urged to watch for further notice of the Society's activities.



Three of Cornell's rocket enthusiasts inspect equipment prior to static test of liquid fuel rocket motor, at the Mohawk Airport.

Tau Beta Pi

The Cornell chapter of Tau Beta Pi, Delta of New York, held its annual fall initiation in December, with the admission of twenty-seven new members. President Andy Mellen, ChemE '53, presided as toastmaster at the banquet in the Dutch Kitchen following the formal initiation.

Enjoyed by undergraduate members and many of the sixty-odd faculty members, the program included the introduction of the alumni initiate, Dr. Theodore P. Wright, M.I.T. '18, vice-president of the University in charge of research. Professor Joseph O. Jeffrey, acting as spokesman for the faculty advisers who judged essays submitted, announced the award of two prizes for the best Tau Beta Pi essays, the judges having been unable to pick one winner. Receiving the awards were Robert F. Conti, ME '53, and Robert M. Messner, ChemE '53.

Mr. Mellen then presented the Tau Beta Pi Woman's Badge with corsage to Janice Button, EP '54, and Joan Forrester, Arch '53, and expressed the hope that women might soon be accepted as full-fledged members of the society.

Robert M. Messner, ChemE '53, responded for the newly initiated members after the expression of congratulations by the president.

The program concluded with an address by Dean R. Lester of General Electric Company in Syracuse, an outstanding young engineer and a member of both Tau Beta Pi and Phi Beta Kappa. Mr. Lester presented an interesting and comprehensive outline of opportunities for engineers in many fields ranging from transistor development and application to color television.

The new members of Tau Beta Pi are the following:

Charles E. Baun, EE '53, Robert M. Bierman, EE '53; Richard M. Bosshardt, EE '53; Richard D. Chalfant, Arch '54; Richardo U. Chicurel, ME '53; Robert F. Conti, ME 53; Richard W. Conway, ME '54; Thomas O. Duff, EE '53; Lester Eastman, EE '53; George H. Ebel, EE '53; Herb R. Epstein, ME '53; Robert Z. Fowler, EE '54; Richard T. Groos, ME '53; John D. Higgins, ME, 53; George W. Holbrook, ME '53; Robert M. Messner, ChemE '53.

Also elected were Henry E. Meurer Jr., ME '54; David W. Nast, EE '53; Richard W. Parker, ME '53; David L. Pope, CE '53; Richard E. Quinn, Arch '53; Robert C. Ready, CE '53; Donald P. Reynolds, EE '53; Robert G. Rutishauser, ME '54; Shoji Sadao, Arch '54; David A. Thomas, MetE '53; George J. Wolga, EP '53.

Report on Prefabs

The prefabricated housing industry has capitalized on the national housing shortage to establish itself solidly in the home-building field, but it will have to do a better "selling job" to continue to gain ground, according to a nationwide study of prefabricated marketing completed by the Housing Research Center at Cornell University.

The survey, which sent interviewers to 43 prefabricated housing plants from coast to coast, found that the average home prefabricator has done little or no market research, maintains only a small sales organization and puts less than 1 per cent of his gross sales into advertising.

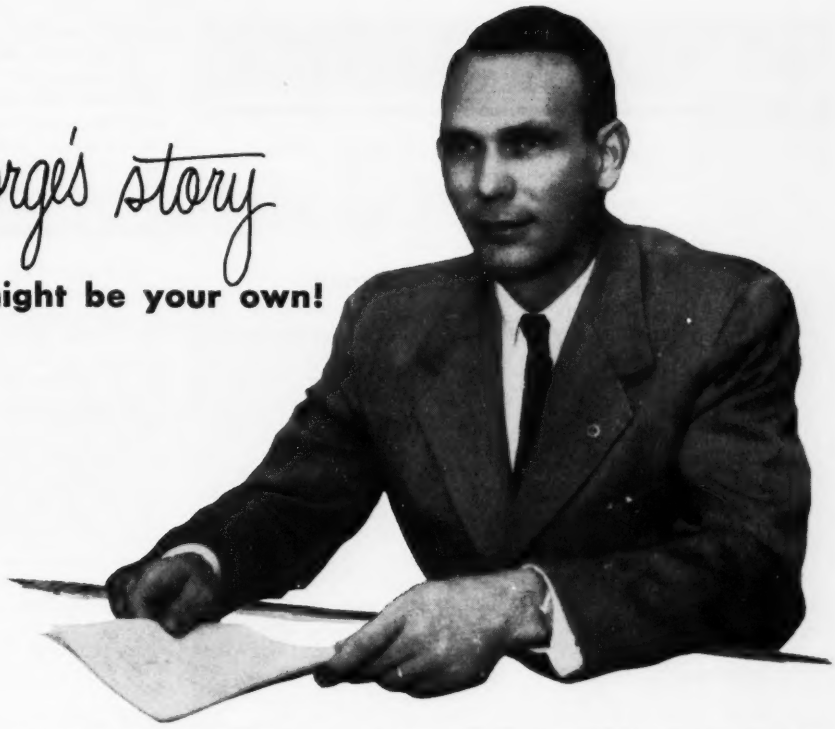
The study was carried out under contract with the Federal Housing and Home Finance Agency. The report, "Practices and Precepts of Marketing Prefabricated Houses," was written by Prof. Glenn H. Beyer, director of the Cornell center, and Theodore B. Yantis.

Most of the homes were sold in what the report labeled a "prefab belt" of Illinois, Indiana, Ohio and Pennsylvania, together with Michigan, Wisconsin, Kentucky and New York.

Participants in the study, in addition to Professor Beyer and Mr. Yantis, included Profs. James W. Partner, Arthur I. Nilsson, Harry J. Loberg, L. D. Brown, and F. F. Hill.

George's story

might be your own!



George L. Cobb is chief engineer of Columbia-Southern's plant at Natrium, West Virginia. He holds the responsible job of supervising the activities of maintenance, engineering and construction. He's a valued member of the Columbia-Southern organization.

Cobb started as a maintenance engineer six years ago, became assistant maintenance superintendent, then was tapped for his present job. But Cobb's story starts before that.

George attended Arkansas A&M and later Alabama Polytechnic Institute as a student in mechanical engineering. He received his degree in 1944, then served in the armed forces for two years.

Immediately upon his return, he sent his personal resume to 34 companies and received replies from 31 of them. He spent one month travelling over 12,000 miles investigating each promising opportunity which included a meeting with the Columbia-Southern people. Many offers were extremely attractive, but Columbia-Southern suited him best.

Why Columbia-Southern? Well, here's what George says.

1. He liked Pittsburgh Plate Glass Company, the parent company, and its reputation.
2. He liked Natrium, West Virginia, and the community surrounding it.
3. Columbia-Southern offered the opportunity to do the type of work he was most interested in—plant maintenance.

Cobb's advice to technical graduates today—"Look for job satisfaction—something one is best suited for. If a man doesn't like his job, he will be neither happy nor successful with it. I've traveled a great deal and have never found a more cooperative group to work with than the people at Natrium. I feel that holds more men to our organization than any other of several important considerations."

Columbia-Southern has opportunities for graduates in all business and technical fields including engineering, research and development, sales, plant design, mining, construction, maintenance, production, accounting, transportation and related fields.

You are invited to write now for further information at our Pittsburgh address or any of the plants.

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CHEMICAL CORPORATION
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ONE OF A SERIES

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AT YOUR SERVICE

Candidacies are invited for the Fuertes Alumni Medal. This Medal perpetuates the memory of Professor Esteven Antonio Fuertes, Dean of the College of Civil Engineering at Cornell University. It is awarded annually by the Faculty of the School of Civil Engineering to a graduate of that School, or to the recipient of a Master's or Doctor's degree at Cornell University with a major in the School, for a meritorious paper on an engineering subject. The paper must advance the scientific or practical interests of the profession of civil engineering. Papers or books printed during the year 1952 are eligible. Manuscripts scheduled for publication will also be considered.

Applications should be sent not later than April 15, 1953, to Professor Andre L. Jorissen, Chairman of the Fuertes Alumni Medal Committee, Lincoln Hall, Cornell University, Ithaca, N.Y.

Information on eligible papers will be gratefully received by the Committee.

ASTE Scholarships

An increase of more than 350% in scholarship aid to American and Canadian college students studying tool engineering and allied subjects has been voted by the Board of Directors of the American Society of Tool Engineers, a 23,000,-member national technical society of production experts.

For 1953 the society is offering ten $700 scholarships to college students in their fourth or fifth year who are taking subjects coming under the general category of tool engineering, including such courses as metal processing, tool design, plant layout, inspection and advanced manufacturing processes.

Applications for the ASTE scholarships must be made before March 1, 1953. Application blanks and details on the scholarships can be obtained from ASTE headquarters at 10700 Puritan Ave., Detroit 21, Michigan.

DuPont Teaching Grants

A postgraduate teaching fellowship—a new type of aid to education—has been granted the chemistry department of Cornell University by the Du Pont Company in a new program of financial assistance, the company announced today.

The purpose of the grants is to improve the teaching of chemistry to undergraduate students by keeping an experienced postgraduate in that work within the department. It offers $2,400 for an unmarried fellow and $3,000 for one who is married, provides $500 to the University for support of his work, and pays tuition and fees. It is for the

(*Continued on Page* 38)

The warm, human story of Cornell's Dean Kimball

I REMEMBER

By Dexter S. Kimball

This fascinating autobiography really makes two stories. It is the record of a machine shop apprentice who became Dean of one of the country's great engineering schools. It is also a nostalgic and vivid account of America's awakening to the miracles of the machine age.

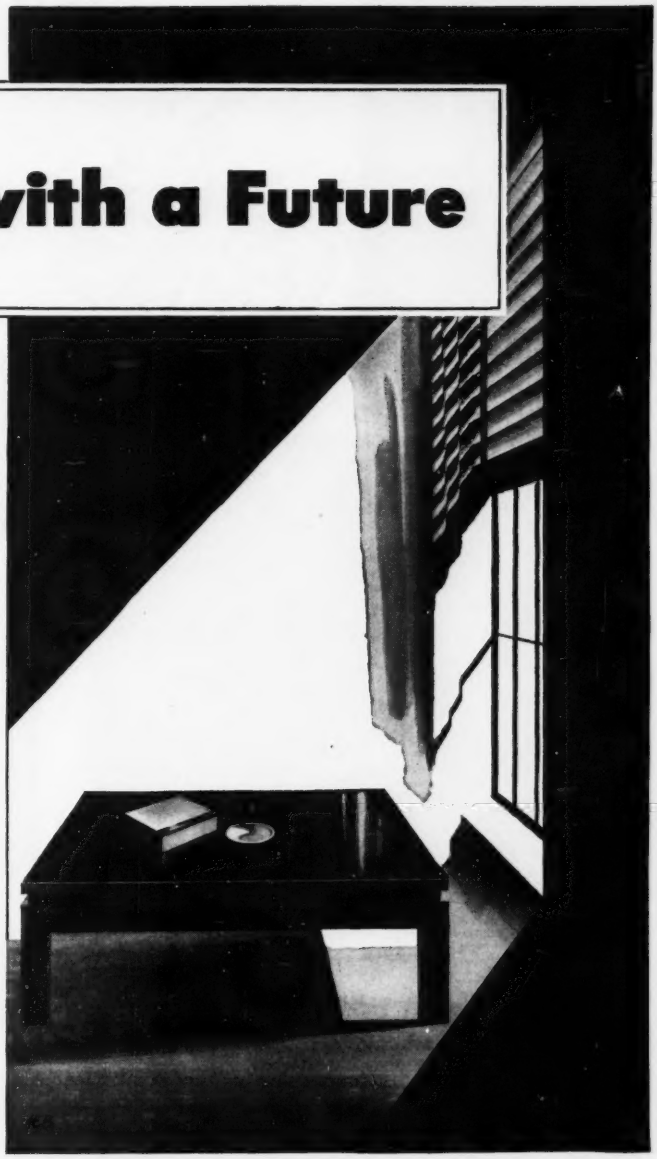
In the clear, animated style of his famous lectures and his lively conversation, Dean Kimball traced the path of his long life—from San Francisco of the eighties to Cornell's campus, from engineering education to engineering practice, and finally to government service in Washington.

To all those who knew Dean Kimball at Cornell and to engineers who recall his distinguished leadership in the ASME, this book offers fascinating and heartwarming reading.

$4.00 at all bookstores

McGRAW-HILL BOOK CO. New York 36, N. Y.

Finish with a Future



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. . . to help lacquer manufacturers produce furniture finishes that stand up when exposed for long periods to sunlight and to extreme heat or cold.

SOLUTION...

. . . lacquer resins made with Hercules P.E., a chemically uniform pentaerythritol, made by Hercules for its own lacquer resins and those of other manufacturers. By adding toughness and flexibility to lacquer resins, P.E. makes possible fine furniture lacquers that do not crack or "craze" under adverse climatic conditions.

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This is but one example of the far-reaching chemical developments in which you could participate at Hercules—in research, production, sales, or staff operations. It suggests the ways Hercules' products serve an ever-broadening range of industries and end-uses.

Hercules' business is solving problems by chemistry for industry . . .

. . . plastics, paint, varnish, lacquer, textiles, paper, soaps, detergents, rubber, insecticides, adhesives, to name a few, use Hercules® synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products and other chemical processing materials. Hercules® explosives serve mining, quarrying, construction, seismograph projects everywhere.

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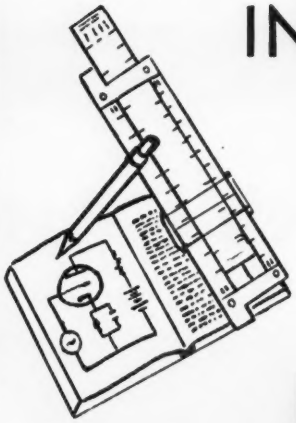
INDUSTRIAL CO

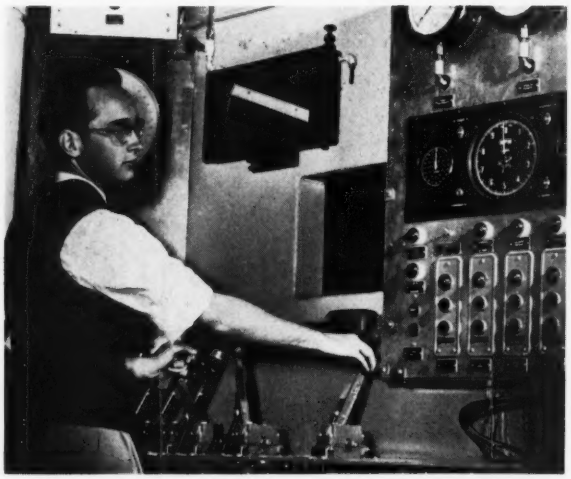
From Principl

By Robert St

All photos by General Electric, I

George Asley, EE '54, records test run data for a G.E. experimental a-c welder.





At General Electric's General Engineering Laboratory, Howard Mitchell, EE '55, operates the controls during the test of a special development engine.

William Mountsier, ME '55, recording temperature in an edible oil processing operation at Procter and Gamble.

Final adjustments before test are made on

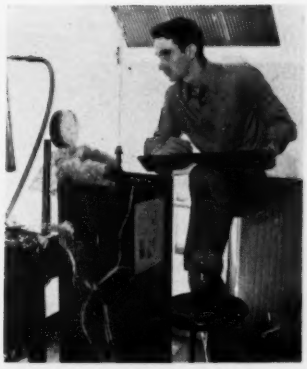
The industrial cooperative plan was started at Cornell in the spring of 1947, and has proved very successful in its six years of existence. There are about twenty men in the program from each class of Electrical and Mechanical Engineers. These men are chosen in the spring of their sophomore year by one of the five cooperative industries, General Electric, Philco, Procter and Gamble, Air Reduction, and American Gas and Electric Company. Then they alternately go to school

)-OP PROGRAM

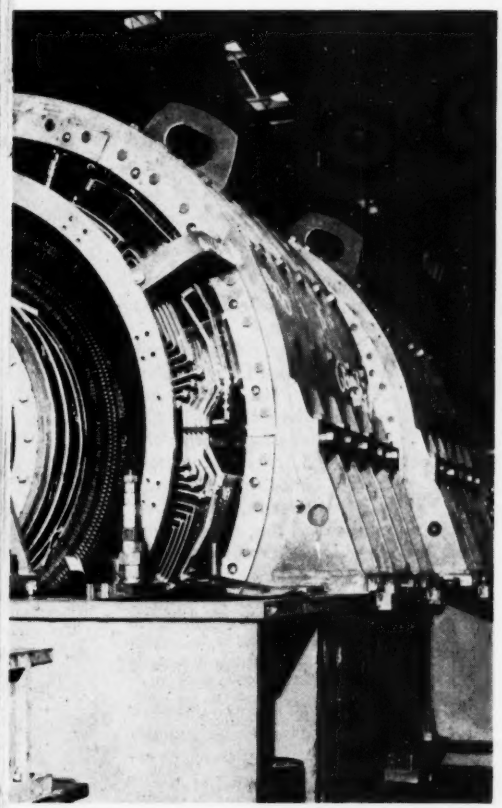
e To Practice

uckelman, EE '54

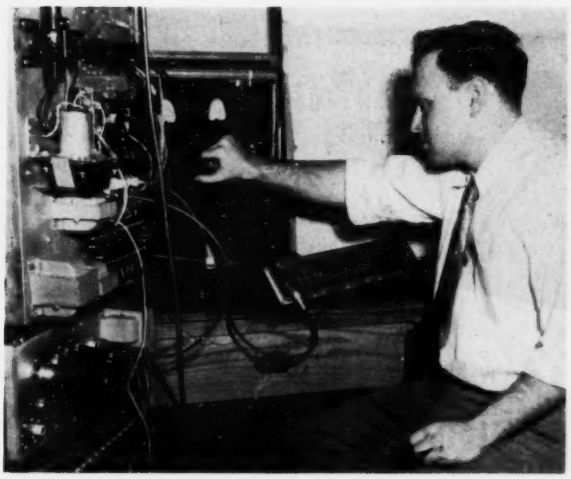
Philco, and Procter and Gamble.



Richard Gauthey, ME '55, taking a temperature reading as part of a quality audit test on a G.E. water cooler.

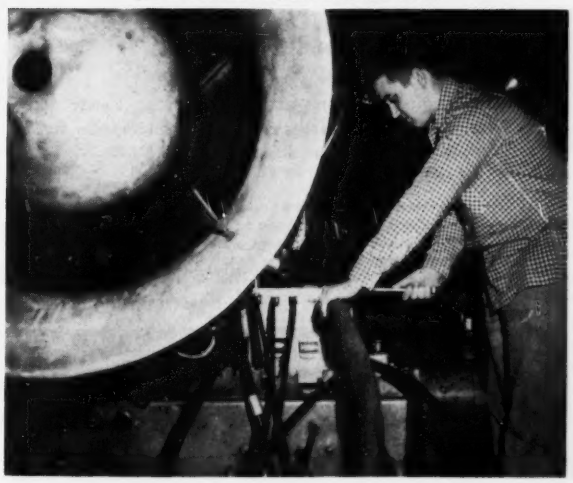


a G.E. generator by Tracy Storer, EE '55.



Arthur Gottesman, EE '55, working an new circuitry in Philco microwave relay equipment.

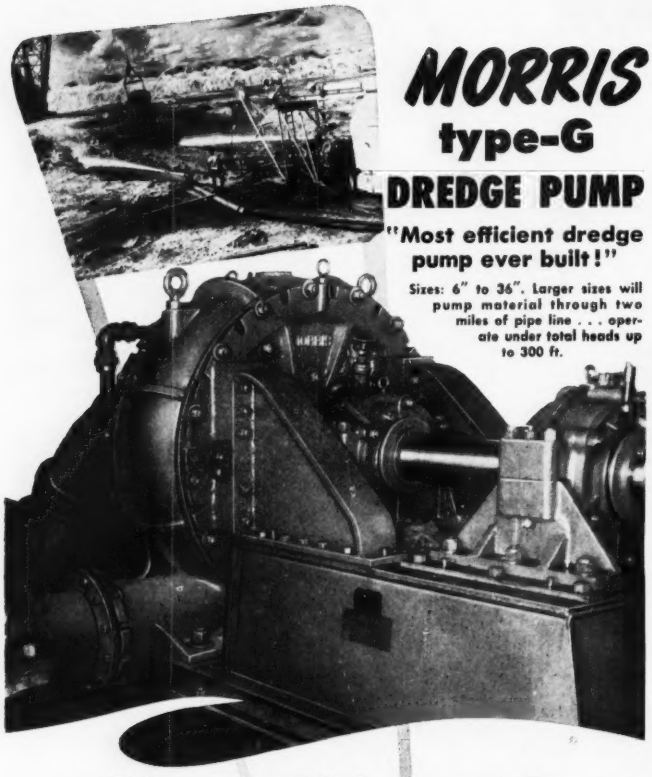
Working on the development of new jet engines is Jack Martin's (ME '55) job at General Electric's Lockheed Plant.



and work in industry for four-month periods, utilizing their summers so as to be able to graduate at the normal time. As the system works out they are with industry one fall, one summer, and one spring, and go to summer school during the years in which they work in the spring and the fall.

The purpose of the program is to acquaint students with the workings of industry while still in school.

The philosophy of cooperative education



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"Most efficient dredge pump ever built!"

Sizes: 6" to 36". Larger sizes will pump material through two miles of pipe line . . . operate under total heads up to 300 ft.

Long life under high output due to efficient design and construction

Specially designed bearings—Stand up under all loads, hydraulic or mechanical, encountered in severest types of dredging work. Anti-friction, self-aligning roller bearings on sizes 6" to 16" —heavy Kingbury bearings for pumps above 16".

Patented pressure balanced impeller—Lasts longer—all parts wear evenly. Shroud on suction side is larger in diameter —balances casing pressure, decreases wear.

Other superior Morris features—Volute-type casing. Interchangeable liners on hub and suction sides. Easily accessible stuffing box. Vibration-free, extra-large, high-grade steel shaft removable through suction side of casing.

The experience of 87 years in the designing and building of pumps is at your disposal. Let our engineers help you select the exactly right pump for your particular needs. No charge or obligation.

JOHN C. MEYERS, JR., B.E.
Executive Vice-President

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Picture Brief

is that students can learn theory and practice in the field to supplement their formal classroom education and above all gain a valuable insight into the organization, operations, human relations, and responsibilities which characterize modern industry.

The students derive three major benefits from this industrial experience.

First, they get a chance to see engineering opportunities in the factory and office, as well as in the lab. Thus they are better qualified to decide what type of job they want when they graduate.

Second, they learn how to study. That is, through experience in industry they gain a sense of values concerning engineering knowledge and can apply this to the material given to them in class, picking out the most important points and learning them most thoroughly. In other words, they can adopt their patterns of learning to what they are going to have to know after they graduate.

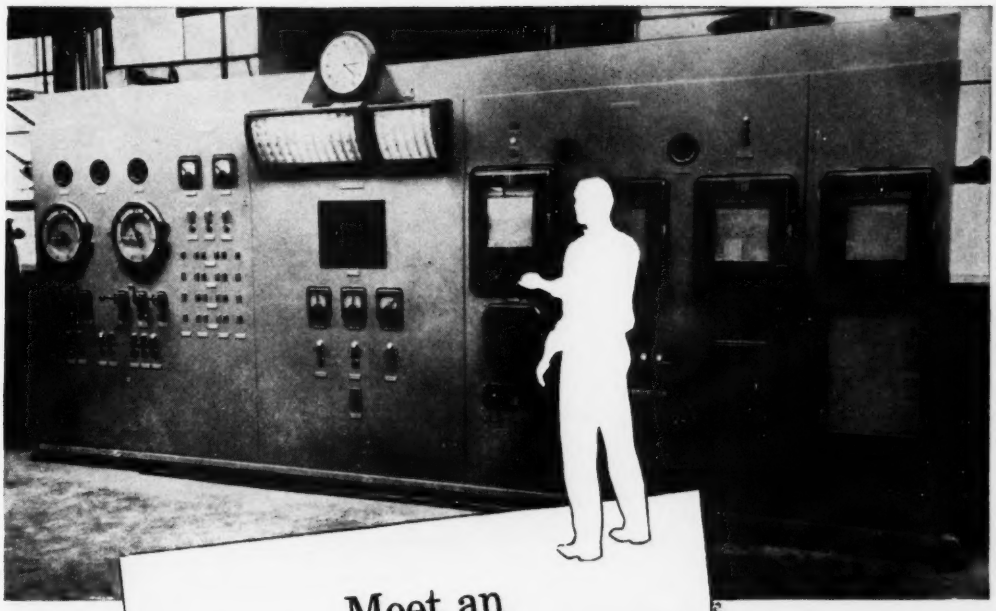
Third, after they graduate, their knowledge of industrial operations will aid in their own personal advancement on the job.

One might ask what benefits the cooperating industries derive from the program. They seem to be very satisfied with it for several reasons.

First, they feel that the work the students do is commensurate with their salaries. Second, a large number of men who cooperate with a company continue working for it afterward, and thus the training the company has given these men will have paid off.

Third, although many co-ops work for other companies after graduation, they may find themselves ordering industrial products of a type produced by the company which trained them. Thus, they may let the contract to this company.

The satisfaction of all parties concerned is a major factor in getting industry, the schools, and the students to cooperate and make the program a primary tool of engineering education. This accounts for cooperative education producing many of the more successful engineers and for the continual expansion of this type of education throughout engineering schools today.



Meet an Engineer-Businessman... Class of '50

● One of the interesting angles of L&N Field Engineering is that you get into it *soon*. You're not rushed —you get full training, and what's more, you're trained as an individual, with full recognition of your present strengths. But, even so, it's only a few months before you're ready for the polishing of field service work, and that in turn swiftly fits you for a business day something like this:

You start off with a visit to, say, a bolt-making plant. There you gather the instrument-engineering facts about a new heat-treating furnace, and make a date to bring in your recommendations for temperature-control equipment . . . You didn't solicit this sales call; the firm is an old L&N friend, and you've been given the responsibility of meeting their present and future requirements.

After lunch you're in another plant, checking instruments. You find one of the instrument relays pretty well shot, and promise to bring in and install a new one.

You're especially happy about your next stop, because they got their first L&N instrument when the manager "bought" your analysis and recommendation for control of a galvanizing kettle-furnace . . . Now, he wants to know how you'd improve the control of a malleableizing furnace.

Back at the office, you talk things over with another sales engineer, who supervises your work. He verifies your ideas about both the controls you discussed with customers; suggests you check one of them with the district manager, in case that new accessory from the home office should be included . . . And he has a request that you call at an aircraft plant tomorrow or the next day.

And so, almost before you know it, you're on the ladder and climbing. This big, long-established firm is helping you develop your talents as engineer-business man, and can use them in your well-paid present and attractive future. Why not make an L&N date through your placement bureau?

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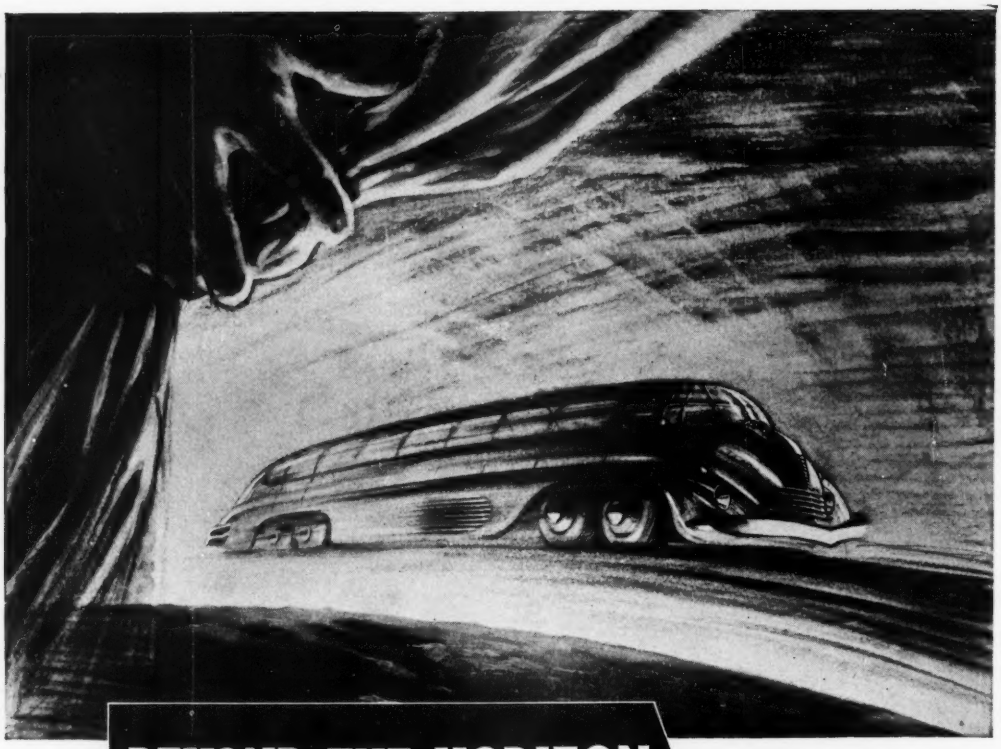

BEYOND THE HORIZON....

Coming developments in transport—still beyond the horizon—will depend very largely upon the new alloys the metallurgists can supply the engineer. The laws of thermodynamics dictate higher temperatures for greater efficiency in engines and, as the addition of Molybdenum to many alloys allows the use of higher temperatures, it will certainly be used more and more in the engines of the future.

Climax furnishes authoritative engineering data on Molybdenum applications.

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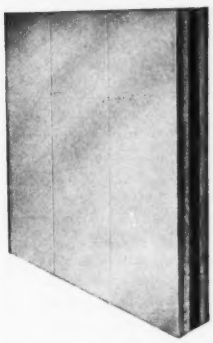
C 21

What's Happening at CRUCIBLE

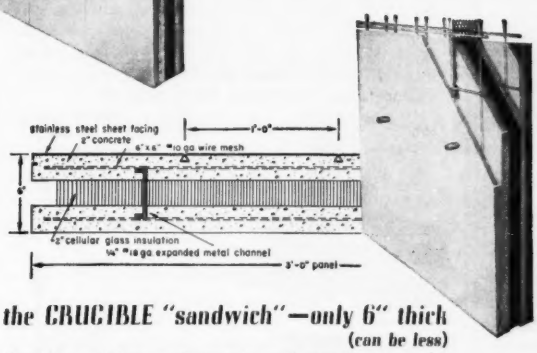
about stainless curtain walls

Modern construction methods have changed walls from the self-supporting type to a mere covering which does not support its own weight for more than one or two stories. Hence the definition of "curtain wall":—the facing or enclosure of the structural steel frame. This frame supports the entire weight of modern buildings.

The need has existed for a covering that would not only clothe the building, but be lightweight, economical and space saving. Because these requirements are more than adequately met with stainless steel curtain wall construction, this method is becoming increasingly popular with cost and space conscious owners, builders and architects.



the CRUCIBLE "sandwich"



the CRUCIBLE "sandwich"—only 6" thick (can be less)

Crucible stainless steel curtain wall panels are in the form of 6-inch thick "sandwiches". The facing consists of flanged, light-gauge stainless steel sheets with a factory, or site-fabricated, sandwich consisting of cellular glass insulation between two layers of concrete with connecting reinforcing. Crucible 18-8 stainless as the outside face offers excellent resistance to weather and fire while providing eternal beauty with a minimum of maintenance; the inside face can be finished or painted to suit the requirements of modern building interiors. Since 18-8 is restricted in use, a good substitute material, type 430 stainless, now government decontrolled, offers the same benefits as 18-8 stainless.

moisture penetration

The unique characteristics of the cellular glass insulation stop moisture vapor migration from one face of the panel to the other. The cellular insulation properly designed and installed assures that condensation will not take place *anywhere* within the sandwich.

insulation

Although less than half as thick as the usual wall construction, this Crucible stainless steel panel construction has more than twice the insulating value. The "U" value (overall thermal conductivity) is approximately 0.15 BTU Hr./Sq.Ft./°F.

fire resistance

The Crucible sandwich met the requirements of a standard 4-hour fire test conducted in the testing laboratories of the National Bureau of Standards. This meets all old building codes and is double, or better, the requirements of modern enlightened building codes.

erection and fabrication

Since a building frame is not precision built, the attachment of the panel walls to the frame is done with fastening devices that provide necessary 3-dimensional adjustment. Panels can be made at the building site, and a 24-hour casting-to-fastening cycle is possible.

technical service available

Though the use of some stainless steel is now restricted, Crucible metallurgists and development personnel are continuing to investigate improved methods of curtain wall and other construction so that better buildings can be built when stainless is more freely available. For more information write: CRUCIBLE STEEL COMPANY OF AMERICA, General Sales and Operating Offices, Oliver Building, Pittsburgh, Penna.

CRUCIBLE first name in special purpose steels

52 years of Fine steelmaking

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa.
National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

Service

(*Continued from Page 30*)

1953-1954 year.

At the same time, Du Pont renewed its grant-in-aid of $15,000 for unrestricted fundamental research in chemistry and its post-graduate fellowship in chemical engineering for the next academic year. The latter provides $1,500 for an unmarried or $2,100 for a married fellow, $1,200 to the University for support of his work, and payment of his tuition and fees.

The fellowship is to be offered to an outstanding graduate student having two years' experience as a half-time teaching assistant in the chemistry department. The recipient will be required to continue to teach on a half-time basis during the time of his appointment.

Primary objective of this plan is to hold the student in teaching for an additional year so that the University can take advantage of the teaching experience gained, instead of losing it as is generally the case now. The fellow is to be nominated by the University's chemistry department.

RCA Grants

Thirty-two students in twenty-five colleges and universities throughout the United States are studying under RCA Scholarships and Fellowships. The object of the scholarship program is to encourage the training of new scientific personnel for the growing requirements of the electronics industry.

RCA Fellowships have been established for graduate students at the following universities: Californit Institute of Technology (Electrical Engineering), Columbia University (Physics), Cornell University (Engineering Physics), New York University (Electrical Engineering), Princeton University (Electrical Engineering), and the University of Illinois (Electrical Engineering).

These will provide assistance to predoctoral graduate students who have marked ability and promise for graduate study and research in electronics, either as a branch of electrical engineering or as an area of study in physics. Applicants must be citizens of the United States and full-time graduate students registered in an approved university. They must be recommended by appropriate university officials. RCA Fellows are eligible for reappointment, but each appointment is for one academic year.

Requests for application blanks and additional information concerning RCA Fellowships administered by the National Research Council should be addressed to: Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Civil Service Positions

The U. S. Civil Service Commission has announced an examination for Engineer positions in the Bureau of Reclamation, and will be glad to send information and application forms to persons who

(*Continued on Page 40*)

Another COMMUNITY REFRIGERATION CENTER Developed with Frick Refrigeration

Entrance to Quick-freezers

In 1927 the Carthage (Missouri) Ice & Cold Storage Company was operating a 30-ton ice tank.

Today the modernized plant makes 110 tons of ice per day; has a dozen city and country routes, ices railway cars and trucks; rents 2,800 lockers; freezes up to 200,000 pounds of eggs, poultry, strawberries, boysenberries, and packing house products daily; operates 600,000 cubic feet of freezers and coolers. The office is air conditioned.

All the cooling loads are carried by ten large Frick refrigerating machines.

Another example of a prosperous COMMUNITY REFRIGERATION CENTER developed with Frick Refrigeration.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, operated over 30 years, offers a career in a growing industry.

Some of the Ten Frick Ammonia Compressors at the Carthage Plant

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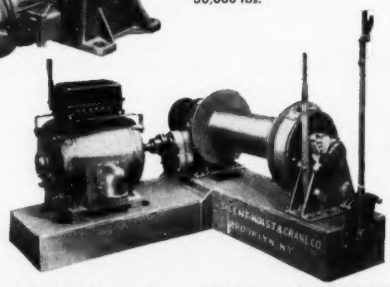

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Takes a lot to lay a carpet in the jungle

The scene is "darkest Africa".

But Africa is lightening. Man's quest for minerals, for new areas for agriculture and trade, is slashing ultra-modern, glaring-white air strips in once impenetrable jungle.

Those pavers, portable air compressors, pumps and air tools—such as you might see working a city street—are Worthington Blue Brutes going to "lay a carpet" in that hole in the jungle.

Thus, Worthington, a major producer of equipment for public works, industry and farm, brings the fruits of American technical genius to the strange places of the world.

And illustrates, too, how the unique American talent of *diversification* helps public, employees and stockholders. For Worthington makes many things—not just construction equipment and pumps, but also engines, water works machinery, power transmission, petroleum equipment, air conditioning and refrigeration, many others.

Such diversification builds *stability* . . . makes Worthington, 112 years old, a strong link in the chain of American business.

Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Harrison, New Jersey.

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Bearing Torture Chamber of a World Champion
Through this spur gear box, a record-breaking speedboat, SLO-MO-SHUN, set a world's straightaway record of 160.3 mph for a mile. Although the straightaway runs were made with a damaged drive shaft, the 3 to 1 step-up ratio in the gear box turned the output (propeller) shaft 11,100 r.p.m. The tandem duplex bearing took a thrust load of 4600 pounds. 5 Fafnir Super-Precision Ball Bearings are used in the gear box . . . another indication that the use of Fafnir Bearings is not limited to one or two industries but is industry-wide. The Fafnir Bearing Company, New Britain, Conn.
Facts about Fafnir
To assure uniformly high standards of quality in Fafnir Ball Bearings nearly one-fourth of Fafnir's employee force is assigned to inspection operations.
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Service

(*Continued from Page* 38)

write to the Commission, at Washington 25, D. C.

Persons applying for the examination must have completed a professional engineering curriculum or have had equivalent experience.

Applications for the examination are to be filed with the Board of Civil Service Examiners at the Bureau of Reclamation in Denver, Colorado. The examination is open until further notice.

The Commission also announces the acceptance of applications for a Student Aid Trainee examination in the fields of physics, chemistry, mathematics, metallurgy, and engineering, for duty in Navy and Army establishments in Washington, D. C., and nearby Maryland and Virginia. Salaries range from $2,750 to $3,175 a year.

This examination is open only to persons who have completed one-fourth, one-half, or three-fourths of a college engineering course or who expect to complete such study within nine months of the date of filing application. A written test will be given.

Further information and application forms may be obtained from the U. S. Civil Service Commission and from first-and second-class post offices. Applications should be sent to the Executive Secretary, Board of U. S. Civil Service Examiners for Scientific and Technical Personnel of the Potomac River Naval Command, Building 37, Naval Research Laboratory, Washington 25, D. C.

Machine Tool Talks

"What are machine tools and what do they do?"

To give the answer to this question to groups of people who are interested, the National Machine Tool Builders' Association has inaugurated a Speaker's Bureau composed of executives of machine-tool building companies.

Any group interested in securing a speaker on machine tools and their function in our production system should write to R. H. McGrath, National Machine Tool Builders' Association, 102525 Carnegie Avenue, Cleveland 6, Ohio.

You can elect an electronic future at GM

The engineers in the picture are using a very simple looking little instrument called the Surfa-Gage.

Yet it is one of the most important contributions of the electronic age to quantity production of quality products.

For the Surfa-Gage allows production engineers to measure the surface of a part to determine the part's conformance to specified smoothness—within micro-inches — and thus insure greater wearing qualities.

We mention the Surfa-Gage here as just one example of the continuous General Motors developments in the field of electronics — from new airplane bombsights and tank range finders to improved car ignition systems, radios and controls for many manufacturing processes.

For we want the soon-to-be-graduated electrical engineer to know that he will find as wide a latitude for his training at GM as will the mechanical or metallurgical engineering student.

After all, the development of modern GM products—of all kinds—requires the development of tools to build those products. And this means a tremendous amount of work in electrical engineering—from the research lab to the production line.

So to the electrical engineer as to engineers in the other categories listed at right—we say there may well be a job with an interesting future for you at GM. Why not ask your College Placement Office to arrange a meeting for you with the GM College Representative the next time he visits your campus. Or drop us a line.

GM POSITIONS NOW AVAILABLE IN THESE FIELDS:

Mechanical Engineering
Electrical Engineering
Metallurgical Engineering
Industrial Engineering
Chemical Engineering

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Editor's Column

Recognizing the need for professional training in agricultural engineering, arising from the highly technical features of modern farming and farm machinery, the Colleges of Engineering and Agriculture recently announced plans for the establishment of a curriculum leading to the degree of Bachelor of Agricultural Engineering. The announcement demonstrates once again how valuable the application of basic engineering principles to the many fields of endeavor within our society can be. For example, consider some of the aspects of agriculture which merit sound engineering analysis—crop and animal production, storage, processing, materials handling and marketing, just to name a few. The services that engineering can render to farming indicate the universal application of its orderly and practical methods.

The new curriculum, however, does more than fill an obvious need. It should offer evidence of the engineering school's awareness of and ability to meet the challenge presented by the almost unbelievable technological progress of our generation. Little time was lost in setting up a course in transitors, the new wonder devices which have revolutionized the field of electronics. The five-year curriculum itself is testimony to the fact that the administration has not been insensitive to the changing demands of industry. Representing a new trend in technical education at the time of its inception in 1947, it has since been under constant study to ensure that it accomplishes the task of turning out well-trained and well-informed engineers. Even now, new changes are being contemplated which will further tailor it to the needs of our complex society. It is reassuring to know that such action is taking place and that we shall assume our positions in the multifarious fields of industry with the most complete and up-to-date education that can possibly be obtained in five years.—D. S.

Prominent Engineer

By WALTER L. JONES, EP '55

Summer jobs for many of us are a rather dull, monotonous way of spending a vacation and financing our way through another eight months of equally dull school.

Andreas von Biel

But occasionally, one of us with ability along some line will find himself engaged in just that line, with the result that he has a whale of a time. For the last two summers, Andreas von Biel has been such a person.

Nor has Andre lived an unexciting life outside of summer employment. He was born here in America in 1932, though both his parents were German. After only four weeks, his family returned with him to Germany. However, these were later a very important four weeks to Andreas.

Andre's father was president of the Hamburg-American Line. The family lived on their estate in the province of Mecklenburg, on the Baltic. They stayed there during the war, where they grew used to the daily bombings. On May 3rd, 1945, the Canadians entered their town, followed ten minutes later by the Russians. The terms of the occupation left the von Biel estate some fifty kilometers inside the Russian zone. Under the Communist program it was immediately split up among the farm workers. Andre and his family were allowed to live on at the estate for a year, probably because they had treated prisoners working on the farm well during the war.

Then one morning at 3 a. m., they were told to leave. Rather than cross the well-guarded zone border only thirty-odd miles from there, they went to southern Germany to try to reach the American section. They crossed the river that was the border with a group of friends, after being fired on by the Russians. Like other events of the war, Andre depreciates this one, saying they were "used to that during the war —nothing unusual." They came to live in Goettingen, where Andre attended boarding school. Food was scarce there. The students took part in no sports and were told to get all the sleep they could, going to bed at nine, so that they could get by on the meager diet.

Then he received word from the American consulate. Because of his birth in this country, he was an American citizen, and they wanted to know if he would like to come to the U. S. He accepted and came over in 1947, staying with a cousin of his mother in Riverdale, N. Y. He knew no English at the time, and so he started as a high school sophomore in an international school in New York. After a year he went to Mount Hebron to finish his preparatory schooling.

Strangely enough, Andre found math almost as hard to get used to as English. He believes it was due to the differences in teaching methods in America and Germany. He applied both to Princeton and to Cornell and was accepted at both. He finally chose Cornell and is now a junior in Electrical Engineering.

He first took an interest in electricity during the war. He used the house's lightning rod as an antenna with near disaster when the first thunder-storm struck. After the war, quite a bit of surplus material was available, and Andre cluttered up the basement thoroughly. His family was against his growing

(*Continued on Page* 44)

Your Future as a Chance Vought... engineer

Chance Vought Aircraft, a designer and builder of military aircraft for 35 years, offers the graduating engineer and scientist an opportunity to join in the design and manufacture of fighter aircraft and guided missiles.

The design of fighter aircraft is constantly being improved as new materials and more powerful engines become available. Guided missile design is in the pioneering stage and progress up to this point, in our opinion, can be compared to the period of development of piloted aircraft prior to World War I. Imaginative thinking as well as sound engineering is an important part of these programs. The young engineer through his creative thinking can rapidly assume a position of engineering responsibility in the Chance Vought organization.

If you are receiving a degree in Aeronautical Engineering, Mechanical Engineering, Civil Engineering, Electrical Engineering, Mathematics or Physics, Chance Vought invites you to discuss your future in these fighter aircraft and guided missile programs. Contact your Placement Director for an appointment with the Chance Vought Aircraft representative.

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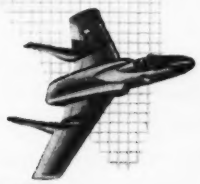
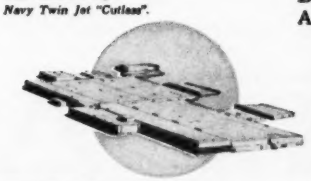


New Chance Vought Navy Twin Jet "Cutlass".



Chance Vought's completely air conditioned, modern plant.

CHANCE VOUGHT AIRCRAFT

Dallas, Texas

DIVISION OF UNITED AIRCRAFT CORPORATION

Andreas von Biel

(*Continued from Page 42*)

up to be an "electrician," a job beneath his standing. However, when he reached New York the first question, of course, was what kind of hobby are you interested in? He was in business from then on.

For a little while Andre toyed with the idea of becoming a chemical engineer. A couple of weeks spent working in a research lab "cured" him, and since then he has concentrated on electrical engineering.

During the summer after his freshman year, he went to work for the Phelps-Dodge electrical lab in Yonkers. He was told to look around for two weeks and see if there was anything he would like to tackle. When he failed to come up with anything they took him down in the basement to a six-foot machine. "This doesn't work," they said. "Fix it." The machine was an eccentricity recorder, a device that measured variations in lead sheathing on cables, a source of trouble in the cable's electrical properties. Andre couldn't quite understand what the inventor had been doing, some twenty years earlier, so he tore it apart and rebuilt it, reducing the number of controls from sixteen to four and producing a machine that worked far better than the original. The company has now patented his machine.

Last year Phelps-Dodge purchased the patent for a new ultra-high-frequency cable from a German Corporation. During the summer, Andre worked on testing apparatus to measure such features of the cable as characteristic impedance, velocity of propagation, attenuation, and the voltage standing wave ratio. The cable's high quality characteristics were beyond the accuracy of existing measuring techniques, leaving them inadequate. The voltage standing wave ratio, specified by the Germans as 1.001, could be read on machines accurate only to 1.003. Finally, one week before school started, Phelps-Dodge decided that the Germans must have been able to measure it, and so flew Andre over to find out how. At the present time he is working on the design of one machine to measure all four characteristics. During holidays and vacations he spends his time at the Yonkers plant working out the "bugs" in his new system.

Andre himself is tall and quite thin; he is light enough to row on the one-fifty crew, an activity which takes most of his time. He speaks in excellent English, hardly marred by a slight, almost unnoticeable accent. He is quiet-spoken, but possesses self-assurance and confidence. He is a member of Phi Kappa Psi and is active in CURW and Orpheus, as well as crew. In spite of his informal education along such lines, he claims to find his basic electrical engineering courses quite interesting. In his own words, "I have been flying over my head." He is now filling in the loop-holes, finding the reasons back of facts he had used empirically.

THIS HAS AN **important bearing** ON YOUR **future**

Elimination of wasteful friction is a constant battle confronting Industry. Out on the job . . . irrespective of your engineering role . . . you'll be coming to grips with this problem.

In *the past*, Industry has learned to rely upon SKF for practical solutions to anti-friction bearing problems.

In *the future* — more than ever before — engineers can look to SKF for the finest in bearings, plus help in putting the right bearing in the right place. 7334

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Wrico Lettering Set **$6.90**

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One templet—with three cap sizes and one numbers—vertical only.

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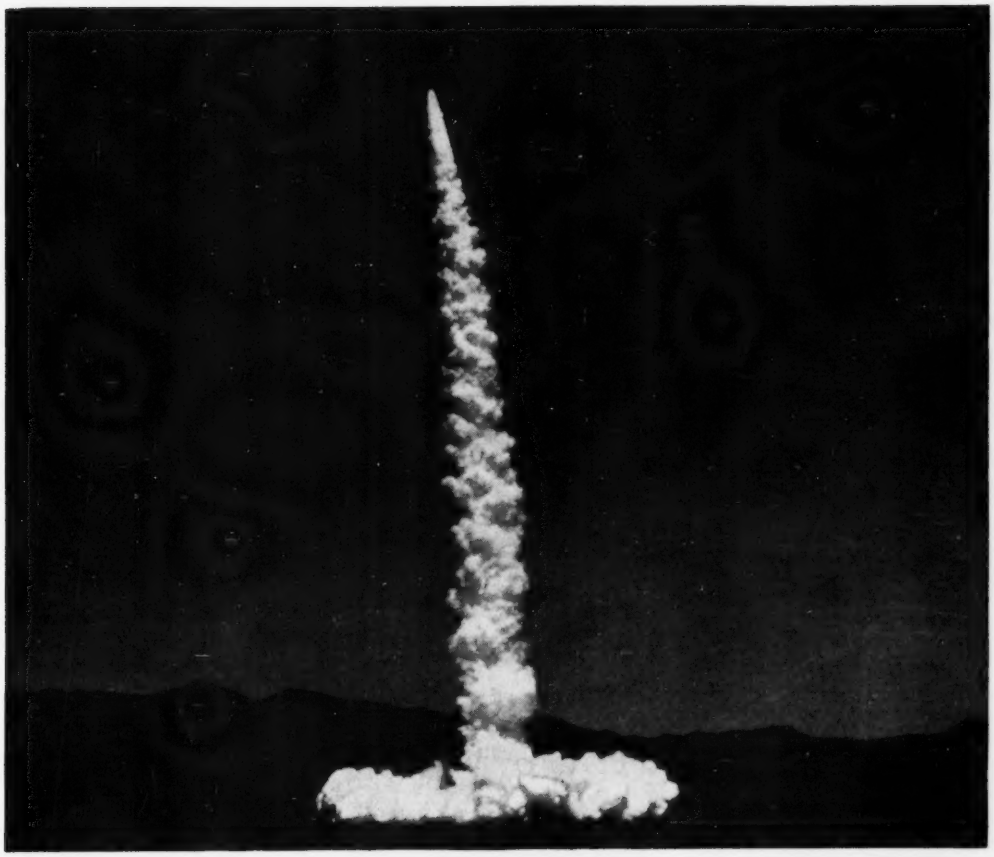


Engineers get ahead at Boeing

A major guided missile program is just one of Boeing's many projects-with-a-future. Other programs, which offer *you* plenty of room to get ahead in engineering, are America's first-announced jet transport project, research in supersonic flight and nuclear-powered aircraft, and development of the B-47 and B-52 jet bombers, the airplanes that have given Boeing more experience with multi-engine jets than any other company.

No other industry approaches this one in offering young engineers such a wide range of experience, or such breadth of application — from pure research to production design, all going on at once.

Aircraft development is such an integral part of our national life that young graduates can enter it with full expectation of a rewarding, long-term career. Boeing, for instance, is now in its 36th year of operation, and today employs more engineers than at the peak of World War II.

Boeing engineering activity is concentrated at Seattle in the Pacific Northwest and Wichita in the Midwest. Both communities offer fine fishing, hunting, golf, boating and other recreational opportunities. Both are fresh, modern cities with fine residential and shopping districts, and schools of higher learning where engineers can study for advanced degrees.

There are openings in ALL branches of engineering (mechanical, civil, electrical, aeronautical and related fields) for work in aircraft **DESIGN, DEVELOPMENT, PRODUCTION, RESEARCH and TOOLING.** Also for servo-mechanism and electronics designers and analysts, and physicists and mathematicians with advanced degrees.

For further information, consult your Placement Office, or write:

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Company, Seattle 14, Washington

BOEING

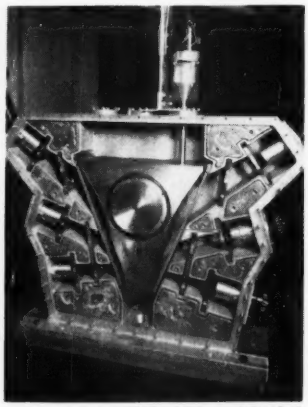
TECHNIBRIEFS

A new spectrometer developed by the National Bureau of Standards makes possible the accurate analysis of X-rays having energies between 0.2 and 12 million electron volts. The magnetic Compton spectrometer, designed and constructed under the direction of Drs. H. O. Wyckoff, J. W. Motz M.S. '42, and W. Miller of the NBS staff, operates in an energy range that bridges the gap left by other types of X-ray spectrometers. The data obtained with the spectrometer are used in studies of the X-ray absorption properties of various materials. It is expected that the spectrometer will also provide information leading to a better understanding of the nature of X-ray production.

The X-ray intensities and energies measured are used in a determination of the amount of shielding required for protection against the dangerous radiations from high voltage machines and nuclear reactors. The Compton spectrometer which was used in an analysis of the gamma-rays emitted from a U^{235} slug at Los Alamos, consists essentially of an evacuated chamber composed of the wedge-shaped pole faces of an electromagnet. A collimated beam of X-rays is made to impinge on a window of beryllium foil. As a result of the interaction of the X-rays with the foil material, electrons are ejected from the foil with an energy and angular distribution dependent upon the energy of the incident photons. Only those electrons that are contained within a small solid angle in the forward direction of the beam are focused on a detector-counter by the magnetic field between the pole faces. The X-ray intensity and energy is then computed from measurements of the magnetic field and the number of electrons striking the detector.

The calculations required for a determination of the X-ray energies and intensities apply only to the electrons produced in the Compton process. At energies above 2 MEV, corrections to the measured counting rate must be made to account for the pair-production electrons, which are aslo ejected from the foil and detected along with the Compton electrons. Such a correction can be made at a given magnetic field strength by reversing the field and measuring the number of positrons.

One of the significant factors in the performance of the Compton spectrometer is the small acceptance angle of the spectrometer baffle. Because of this small angle, the Compton electron energy can be related uniquely to the incident photon energy. Another significant factor concerns the detection sensitivity of the spectrometer. To achieve a reasonably good counting rate with a small beryllium foil requires high X-ray intensities. The resolution of the spectrometer can be varied from 3 to 30 percent by changing the geometry and the foil size.



—National Bureau of Standards

Inside view of the NBS magnetic Compton Spectrometer.

Creosoted Poles

Use of creosote-treated pine poles has made possible the construction of shops, warehouses, and barns that will last without the aid of foundations, footings or excavations. Other advantages are that it saves steel and can be erected quickly on a bulldozed site.

Easily obtainable 25 ft. poles are set four feet into the ground to provide a frame for the building. The roof is framed with timber, and siding is nailed to the ends and sides to close in the structure. Bolts are not needed since the whole building is nailed.

Generally, it is advisable to have a well-drained, fairly level site. The ground can be packed down, or gravel or asphalt can be used for flooring.

One popular use is in the midwest, where this type of building is used to protect and feed cattle and sheep. Trucking companies use this structure to house equipment, often having one side open to save the cost of hanging large doors.

Big Blast in Ontario

A carefully engineered blast at the International Nickel Company's Frood-Stobie mine in Ontario broke up two huge blocks containing 400,000 tons of nickel-copper ore. The blast required 64 tons of explosives and the drilling of some 2,000 blastholes totalling more than 31 miles in length.

These two blocks were left after four shafts had been mined through from the 600 foot level of the mine to the pit floor; the top half had been removed from two of the pillars of ore left as support. Each pillar measured 70x200x150 feet high.

An intricate, carefully studied and planned system of drilling, wiring, and detonation caused the complete breaking down of the blocks in one blast. Reduced to handling proportions, the broken pieces of ore would fill a train of freight cars 14 miles long.

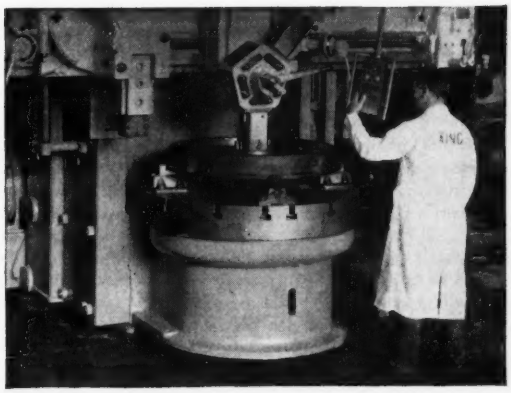
Radioactive Gases

Continuous studies of gases discharged into the air from the Knolls Atomic Power Laboratory in Schenectady have shown that the radioactivity of these gases is no more than or often less than the radioactivity of the normal atmosphere.

The laboratory is working on atomic power plants for U.S. Navy submarines. This involves use of uranium 235 and other elements which release nuclear energy through fission. The gasses are discharged through a 100-foot stack;

(*Continued on Page* 48)

Another page for **YOUR BEARING NOTEBOOK**

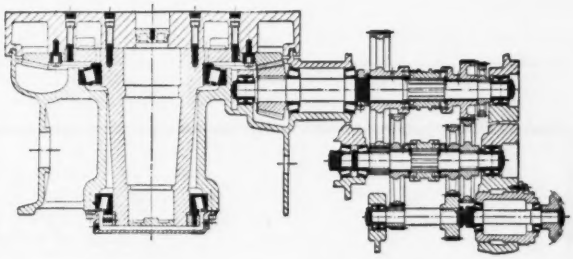


How to keep a high speed boring mill accurate

To insure table accuracy in high speed boring mills, spindle vibration must be eliminated. That's why designers mount the table spindles on Timken® precision tapered roller bearings. They hold spindles in positive alignment, eliminate vibration. Line contact between rollers and races of Timken bearings provides extra load-carrying capacity. The true rolling motion and incredibly smooth surface finish of Timken bearings practically eliminate friction and wear within the bearing itself.

How spindle and drive shafts are mounted on TIMKEN® bearings

The drive of a high speed boring mill is mounted on single row type TS, and two row type TNA bearings. Input, intermediate and bevel pinion shafts are mounted on two type TS bearings on one end, and a two row type TNA bearing free to float on the opposite end. Single row type TS bearings are indirectly mounted on the main table vertical spindle.



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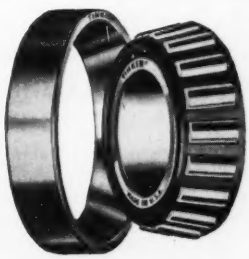
TAPERED ROLLER BEARINGS



Want to learn more about bearings?

Some of the engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'll be glad to help. Clip this page for future reference, and for a copy of the 270-page General Information Manual on Timken bearings, write today to The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL ◐ AND THRUST —◐— LOADS OR ANY COMBINATION ✳

Technibriefs

(*Continued from Page* 46)

their radioactivity must be kept down to assure the safety of the neighborhood.

The studies include checking the concentration of radioactive material at various points near the ground with constant air monitors placed at selected sites. Analyzation of plant samples is done regularly to evaluate radioactive accumulation on vegetation.

Passing the waste gases through a "scrubber" is the first part of the safety operation. In this, a caustic solution washes out the larger radioactive particles and most of the more volatile components. Next, a high filtering system removes more than 99.9% of the small quantity of radioactive material left. The remaining air is then diluted, from 1,000 to 10,000 times, with filtered air from the building's ventilation system.

Upon discharge through the stack, the air is often cleaner radioactively than the atmosphere, since the latter contains measurable but harmless quantities of radioactive elements. The filtered ventilating system removes these particles from the air used to dilute the gases.

Mylar Plant To Rise

The Du Pont Company has announced that it will start construction early this year on a plant south of Circleville, Ohio, for manufacture of "Mylar" polyester film, a new product which was developed and is being made on an experimental basis in the company's Yerkes Research Laboratory in Buffalo.

Cost of the initial installation at Circleville is estimated at approximately $10,000,000. The plant, which will be operated by the Company's Film Department, is expected to go into production early in 1955. It will employ about 250 persons when production reaches capacity.

"Mylar," an entirely new film with unusual strength, heat resistance and insulating qualities, was developed by Du Pont through one of its fundamental research programs.

Mylar has great strength, from two to eight times that of other commerical films. Its tensile strength is 25,000 pounds per square inch, about one-third that of some steels. Its impact strength is at least twice that of any known commercial film. Thus it can be made in thinner gauges, as fine as a quarter of one-thousandth of an inch.

As an insulator, it can be used in surrounding temperatures as high as 200C (392F) and as low as minus 70C (94° below zero F), and still retain most of its strength and insulating qualities.

It has high dielectric strength, or insulating power, without excessive power loss, making it suitable for conductor insulation. Insulation for electric motors requires mechanical strength, long-term resistance to heat, chemical inertness, and high insulating power—all of

(*Continued on Page* 52)

LAVA

Manufacturers of Super-Refractories Only

◇

REFRACTORY CRUCIBLES
GRAPHITE CRUCIBLES
HIGH-TEMPERATURE CEMENTS
SPECIAL REFRACTORY BRICK, TILE, SHAPES

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From the Following Materials:—

GRAPHITE — SILICON CARBIDE — FUSED ALUMINA — MULLITE
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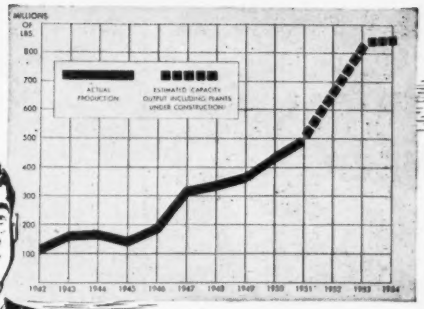
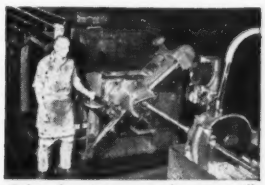
LAVA CRUCIBLE-REFRACTORIES CO.
PITTSBURGH, PA.



Reynolds expanding production —historic chapter in 33 years of continuing growth.

A Fertile Place for Careers to Grow...

Settling tanks, where impurities are separated from sodium aluminate



Tube drawing, one of many mill operations at Reynolds

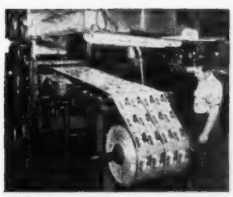
A broad vista of opportunity opens up for college graduates who come to work for Reynolds. The phenomenal rise of the Reynolds Metals Company, known throughout business and industry, is clearly depicted by the above chart. The five-fold expansion in total production of aluminum ingot alone spells broad opportunity. Add to this the vast and productive fabricating facilities of Reynolds —in themselves an enterprise of considerable proportions—and here indeed is a fertile field for any ambitious engineer.

From bauxite mining through metals refining and fabrication to application engineering, sales and marketing, Reynolds offers broad career opportunities. Operating 27 plants in 13 states, and still expanding, there is virtually no limit to what can be accomplished by a capable graduate engineer.

Preliminary orientation in production and sales...direct on-the-job training...liberal insurance, hospitalization and retirement programs...these are all parts of a sound personnel policy maintained at Reynolds.

For important information on "your future in Aluminum," *mail the coupon.* If you are definitely interested now, write direct to General Employment Manager, Reynolds Metals Company, 3rd and Grace Streets, Richmond 19, Va.

REYNOLDS ALUMINUM



Foil—for many uses, including colorful, protective packages and labels; also famous Reynolds Wrap.

Full color movies tell the fascinating story of Reynolds Aluminum. 16mm films available for group showings.

Reynolds Metals Company,
Employment Dept.
Richmond 19, Virginia

Please send me, **FREE,** your 96-page booklet "The ABC's of Aluminum"; also the 44-page book, "Reynolds Aluminum ... and the Company that makes it."

Name_____

Address_____

School_____ **Class**_____ **Course**_____

to the

ELECTRICAL ENGINEER

or

PHYSICIST

with an interest in

RADAR

or

ELECTRONICS

Hughes Research and Development Laboratories, one of the nation's leading electronics organizations, are now creating a number of new openings in an important phase of their operation.

Here is what one of these positions offers you:

THE COMPANY

Hughes Research and Development Laboratories, located in Southern California, are presently engaged in the development and production of advanced radar systems, electronic computers and guided missiles.

THE NEW OPENINGS

The positions are for men who will serve as technical advisors to government agencies and companies purchasing Hughes equipment—also as technical consultants with engineers of other companies working on associated equipment. Your specific job would be essentially to help insure successful operation of Hughes equipment in the field.

THE TRAINING

On joining our organization, you will work in the Laboratories for several months to become thoroughly familiar with the equipment which you will later help users to understand and properly employ. If you have already had radar or electronics experience, you will find this knowledge helpful in your new work with us.

WHERE YOU WORK

After your period of training—at full pay—you may (1) remain with the Laboratories in Southern California in an instructive or administrative capacity, (2) become the Hughes representative at a company where our equipment is being installed, or (3) be the Hughes representative at a military base in this country—or overseas (single men only). Compensation is made for traveling and moving household effects, and married men keep their families with them at all times.

YOUR FUTURE

In one of these positions you will gain all-around experience that will increase your value to our organization as it further expands in the field of electronics. The next few years are certain to see large-scale commercial employment of electronic systems. Your training in and familiarity with the most advanced electronic techniques now will qualify you for even more important future positions.

How to apply:

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Engineering Personnel Department
Culver City, Los Angeles County, California

See your Placement Office for appointment with members of our Engineering Staff who will visit your campus. Or address your resumé to the Laboratories.

An invitation to Grow with Goodyear

No other company engaged in the manufacture of aircraft and plane components offers you such a wide variety of opportunities as Goodyear Aircraft Corporation—for more than 40 years an important contributor to America's progress in the air.

Goodyear pioneered in the use of high strength aluminum alloys in this country, contributing to the development and applications—and has long since become one of the leaders in light metals, design and fabrication. Countless developments, including the first pneumatic airplane tire in 1910, airplane wheels, disc type brakes, cross-wind landing gear, have helped to build aviation's present position.

In World War II, Goodyear Aircraft grew to be one of the nation's largest producers of military aircraft—producers of complete military aircraft *and* of components for more than a dozen front-line ships of all classes. Today, too, GAC is still active in this field.

In lighter-than-air, Goodyear Aircraft is the world's largest builder of airships, including the new Navy N-type airship—which is the largest non-rigid airship ever built, being nearly twice the size of the K-ships of 1941-45.

Long the leader in its field, Goodyear Aircraft Corporation is again vitally concerned with defense projects. But we go far beyond anything the past has produced. Our output now includes complete airships as well as many aircraft components. We are also active in many other new fields—ranging from plastics fabrication and design to guided missiles and electronic computers.

This wide variety of production, coupled with a desire to build and maintain an outstanding engineering staff, enables us to issue you this invitation to grow with Goodyear Aircraft. You'll find unlimited opportunity for advancement—*and an assured future*—at Goodyear Aircraft.

ENGINEERS WANTED

to investigate the outstanding opportunities in research, design and development of:

AIRPLANES, AIRSHIPS, HELICOPTERS, GUIDED MISSILES, AIRCRAFT COMPONENTS, WHEELS AND BRAKES, GROUND-AIR AND SHIPBOARD RADAR STRUCTURES, ELECTRONIC COMPUTERS, GUIDANCE SYSTEMS, TRANSPARENT ENCLOSURES, REINFORCED PLASTICS, RADOMES, BONDED SANDWICH STRUCTURES and many more.

Submit a brief resumé of your qualifications and experience or write us today for an application blank and further information. Prompt consideration is assured. Address SALARY PERSONNEL DEPARTMENT, GOODYEAR AIRCRAFT CORPORATION, Akron 15, Ohio.

GOODYEAR—The Company With COMPLETE Coverage of the Aeronautical Field

GOODYEAR AIRCRAFT

Technibriefs

(*Continued from Page* 48)

which the film has.

Although Du Pont expects the electrical field to be the largest single market for the new film, exploratory work has been started in developing such diverse fields as industrial tapes, magnetic sound-recording tapes, packaging, laminations with other materials, lightweight storm windows, and tack-on glazing for farm buildings.

Synthetic Saucers

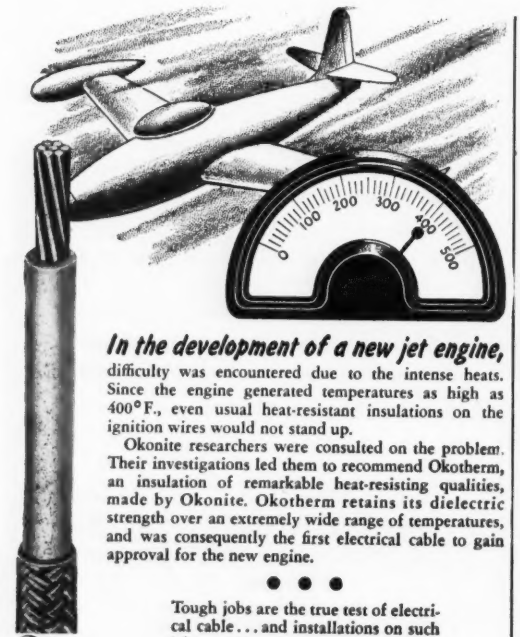
An electrical discharge phenomenon produced in a vacuum bell jar at the Engineer Research and Development Laboratories, Fort Belvoir, Virginia, may be a possible solution to the mystery of "flying saucers," according to Noel W. Scott, physicist.

Working with the vacuum bell jar on experiments in mirror and lens coating, Mr. Scott produced an eerie orange object that bears a striking similarity to the "flying saucers" that many claim to have seen.

For the press, Scott demonstrated the "saucers" and made them behave very much like the real thing. He pumped air out of the bell jar to create a partial vacuum. The air left in the jar was electrified by discharge between highly charged electrodes. He then introduced air from the outside which caused a relatively bright glow to form on some portions of the positive electrode. By varying the amount of air introduced into the jar the color of the "saucers" was varied from orange-red to purple, pink to white. The introduction of helium into the chamber produced a green "saucer."

The "saucers" were produced in many of the shapes that have been sighted to date. A wave of a magnet outside the jar and the laboratory-made "saucers" skirted elusively about the rim of the jar, stood still, reversed their fields, and in general behaved very much like the real things are said to behave. "The saucers," Mr. Scott said, "remain stationary, move at an excessive rate of speed, or change direction almost instantly by altering the direction and intensity of the rays and the electric and magnetic fields, and by changing the atmospheric pressure. This may explain why airplanes, attempting to fly near them, have failed in detecting or sighting them. Once any factor responsible for the formation of this phenomenon is changed, the "saucer" might completely engulf an object, attach itself to it, repel it or fade out completely. Scott also stated the "saucers" have enough substance to cause "blips" and be picked up on radar screens.

He stated, "The atmospheric conditions necessary for producing this phenomenon are not the *prevailing* conditions that exist in the upper atmosphere. However, it is not altogether improbable that there may be 'occasional' local conditions responsible for this glow which might be interpreted as 'flying saucers'."



In the development of a new jet engine, difficulty was encountered due to the intense heats. Since the engine generated temperatures as high as 400°F., even usual heat-resistant insulations on the ignition wires would not stand up.

Okonite researchers were consulted on the problem. Their investigations led them to recommend Okotherm, an insulation of remarkable heat-resisting qualities, made by Okonite. Okotherm retains its dielectric strength over an extremely wide range of temperatures, and was consequently the first electrical cable to gain approval for the new engine.

● ● ●

Tough jobs are the true test of electrical cable . . . and installations on such jobs usually turn out to be Okonite.

OKONITE insulated wires and cables

3788

THE BUILDER

A new biography of Ezra Cornell by Phillip Dorf, published early in December and already a best-seller among Cornellians. Mr. Dorf has consented to autograph copies of his fine book for all Campus Store customers.

$5.00
postpaid

WILD-LIFE VOICES

Recorded by Professors P. P. Kellogg and A. A. Allen for the Albert R. Brand Bird Song Foundation of Cornell.

NORTH AMERICAN BIRD SONGS VOL. 1. Album of 6 10" double records.....**$8.50**

NORTH AMERICAN BIRD SONGS VOL. 2. Album of five 12" double records.....**$10.50**

VOICES OF THE NIGHT
The calls of 26 frogs and toads. Album of four 10" double records.....**$6.50**

FLORIDA BIRD SONGS
Songs of 10 southern birds on one 10" double record **$2.50**

All shipped postpaid

THE CORNELL CAMPUS STORE
Barnes Hall Ithaca, N. Y.

Graduate Engineers!

ENJOY GOOD SALARY FROM THE FIRST DAY... INTERESTING CHALLENGES RIGHT AWAY!

At Sperry you can apply your knowledge immediately and keep on learning—with pay—in research, product development, or field work. Salary increases come as you progress.

You enjoy the advantages of working with the leaders in their fields. You are expected to use originality and a fresh approach. Every project is a creative challenge to the brain-work and the team-work of the Sperry engineering staff.

VARIETY OF OPENINGS

There are opportunities for aeronautical, electrical, electronic, mechanical engineers – physicists – technical writers and field engineers for applied engineering.

ATTRACTIVE LOCATIONS GOOD WORKING CONDITIONS

Long Island—In pleasant suburban atmosphere but convenient to New York. Modern plant. Well equipped laboratories. Excellent working facilities.

In the Field—There are excellent applied engineering opportunities in various sections of the United States and abroad.

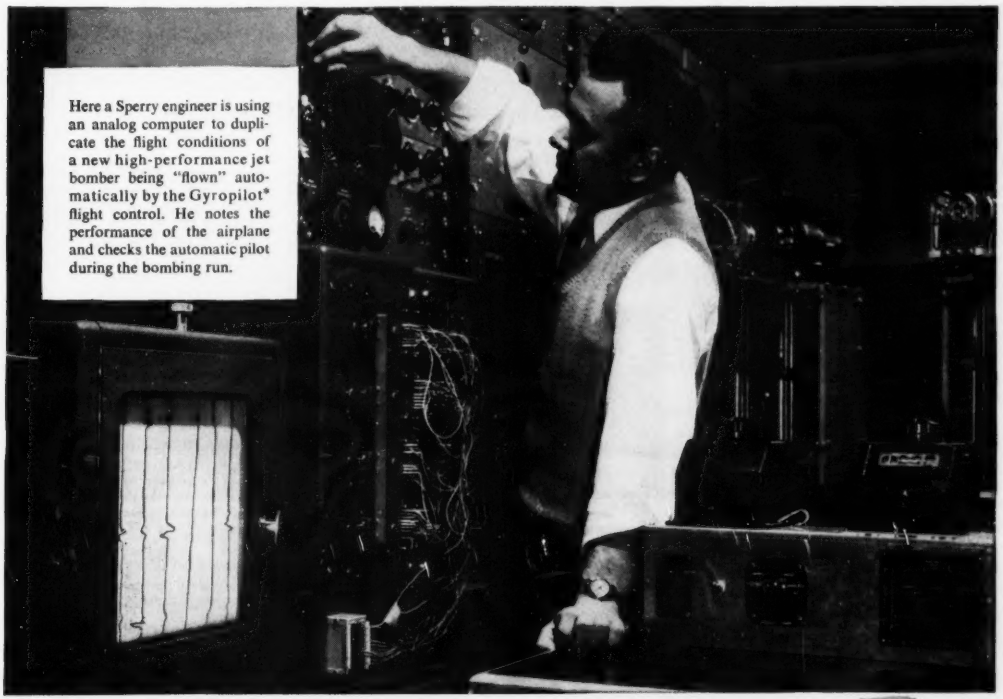
In All Locations—The way is clear for steady advancement. You are encouraged to continue your education while you earn. And liberal employee benefits are provided for all.

RESEARCH LEADERSHIP... A FORTY-YEAR TRADITION

Today Sperry is the recognized leader in developing automatic controls for navigation. From Sperry's work in gyroscopics and electronics have come the Gyropilot* flight controller, Zero Reader* flight director, radar, servomechanisms, computing mechanisms and communications equipment.

Sperry sponsored the development of the klystron tube—the first practical source of microwave energy. From Sperry pioneering has come a complete line of Microline* instruments for precision measurement in the entire microwave field.

CHECK YOUR PLACEMENT OFFICE FOR DATES WHEN SPERRY REPRESENTATIVES WILL VISIT YOUR SCHOOL...OR WRITE SPERRY EMPLOYMENT SECTION 1A5.



Here a Sperry engineer is using an analog computer to duplicate the flight conditions of a new high-performance jet bomber being "flown" automatically by the Gyropilot* flight control. He notes the performance of the airplane and checks the automatic pilot during the bombing run.

SPERRY GYROSCOPE COMPANY
DIVISION OF THE SPERRY CORPORATION

*REG. U. S. PAT. OFF.

GREAT NECK, NEW YORK · CLEVELAND · NEW ORLEANS · BROOKLYN · LOS ANGELES · SAN FRANCISCO · SEATTLE
IN CANADA – SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC

What Are They?

- ☐ *Thrust bearings*
- ☐ *Clutch disks*
- ☐ *Grinding wheels*
- ☐ *Ceramic insulators*

The correct answer is grinding wheels, shown as they emerge from the electric kiln.

Not ordinary grinding wheels, however. They are Norton *New-Process* Wheels — made by modern, streamlined, precision methods developed by Norton engineers.

A Big Step Forward

This new process involves advanced equipment, new manufacturing techniques, and close quality control during every step of grinding wheel production. As a result, Norton *New-Process* Wheels are produced to a degree of structural uniformity never before possible.

This increased uniformity means extra assurance of consistent grinding action throughout each wheel and from wheel to wheel. Which, in turn, means more evenly wearing, longer lasting wheels — together with more cutting action per wheel and per dollar.

In addition, the built-in balance of Norton *New-Process* Wheels cuts down vibration and enables them to hug the work more closely, assuring smoother, better grinding performance.

A wide range of wheels employing both ALUNDUM* (aluminum oxide) and CRYSTOLON* (silicon carbide) abrasives are made by the new process.

Looking Ahead With Norton

Geared to industry's constantly expanding needs, Norton Company serves *every* manufacturing field by "making better products to make other products better." Young men planning technical careers are invited to consider the established leadership and far-ranging scope of the Norton world-wide organization.

Send For Additional New-Process Facts

Recent Norton literature gives further details on this important advancement in grinding wheel manufacture and performance. Write for your free copy.

John J. Amero, M. S., Cer. Eng., North Carolina State '38, checks duplication of grinding wheel grade with the aid of an oscillograph. John has been working on the development of Norton "New Process" wheels.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

ABRASIVES · GRINDING WHEELS · OILSTONES · ABRASIVE PAPER & CLOTH

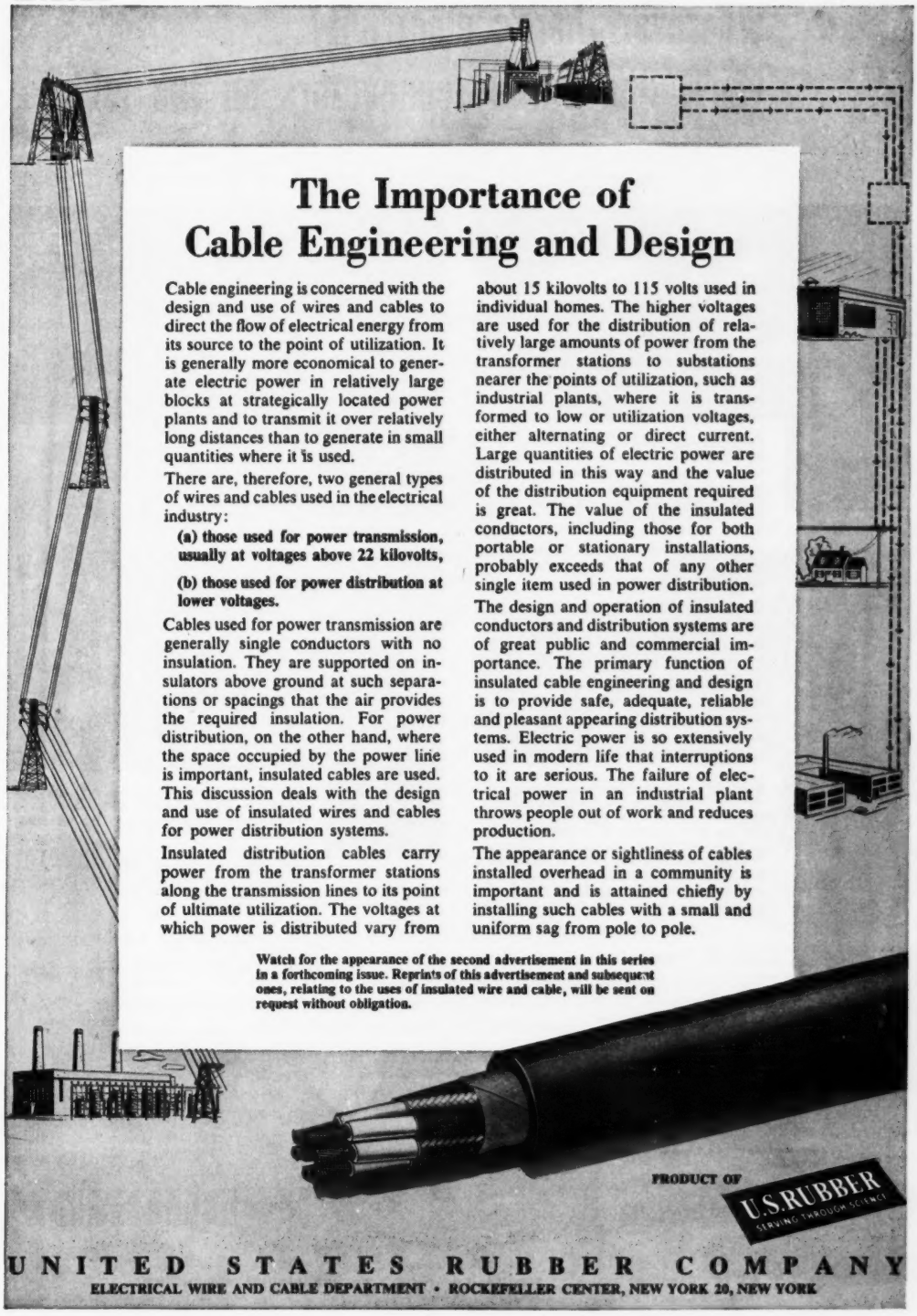
REFRACTORIES, POROUS MEDIUMS & LABORATORY WARE · NON-SLIP FLOORING

GRINDING & LAPPING MACHINES · BORON CARBIDE PRODUCTS

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

BEHR-MANNING, TROY, N. Y. IS A DIVISION OF NORTON COMPANY

No. 1 In a Series



The Importance of Cable Engineering and Design

Cable engineering is concerned with the design and use of wires and cables to direct the flow of electrical energy from its source to the point of utilization. It is generally more economical to generate electric power in relatively large blocks at strategically located power plants and to transmit it over relatively long distances than to generate in small quantities where it is used.

There are, therefore, two general types of wires and cables used in the electrical industry:

(a) those used for power transmission, usually at voltages above 22 kilovolts,

(b) those used for power distribution at lower voltages.

Cables used for power transmission are generally single conductors with no insulation. They are supported on insulators above ground at such separations or spacings that the air provides the required insulation. For power distribution, on the other hand, where the space occupied by the power line is important, insulated cables are used. This discussion deals with the design and use of insulated wires and cables for power distribution systems.

Insulated distribution cables carry power from the transformer stations along the transmission lines to its point of ultimate utilization. The voltages at which power is distributed vary from about 15 kilovolts to 115 volts used in individual homes. The higher voltages are used for the distribution of relatively large amounts of power from the transformer stations to substations nearer the points of utilization, such as industrial plants, where it is transformed to low or utilization voltages, either alternating or direct current. Large quantities of electric power are distributed in this way and the value of the distribution equipment required is great. The value of the insulated conductors, including those for both portable or stationary installations, probably exceeds that of any other single item used in power distribution.

The design and operation of insulated conductors and distribution systems are of great public and commercial importance. The primary function of insulated cable engineering and design is to provide safe, adequate, reliable and pleasant appearing distribution systems. Electric power is so extensively used in modern life that interruptions to it are serious. The failure of electrical power in an industrial plant throws people out of work and reduces production.

The appearance or sightliness of cables installed overhead in a community is important and is attained chiefly by installing such cables with a small and uniform sag from pole to pole.

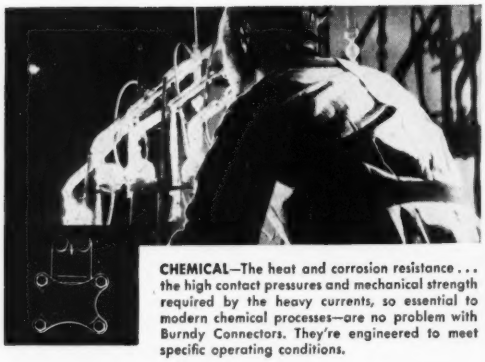
Watch for the appearance of the second advertisement in this series in a forthcoming issue. Reprints of this advertisement and subsequent ones, relating to the uses of insulated wire and cable, will be sent on request without obligation.

PRODUCT OF U.S.RUBBER SERVING THROUGH SCIENCE

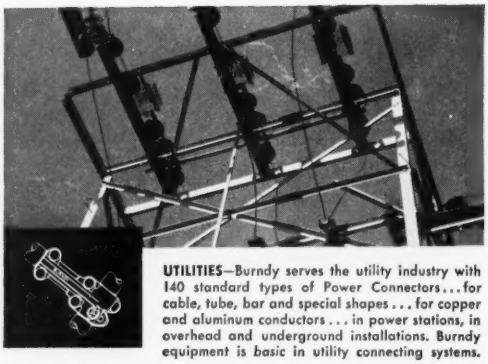
UNITED STATES RUBBER COMPANY

ELECTRICAL WIRE AND CABLE DEPARTMENT • ROCKEFELLER CENTER, NEW YORK 20, NEW YORK

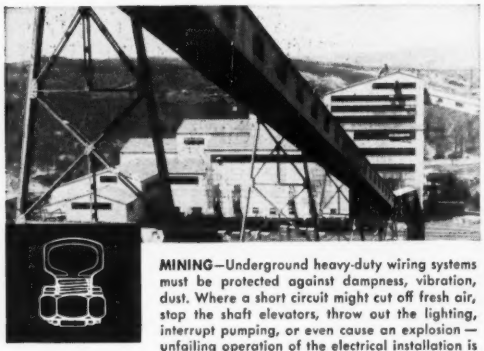
Wherever there's electricity... you'll find Burndy connectors on the job!



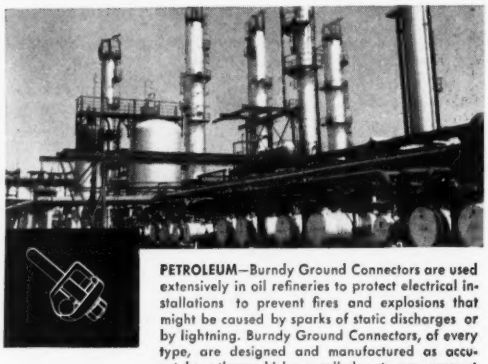
CHEMICAL—The heat and corrosion resistance... the high contact pressures and mechanical strength required by the heavy currents, so essential to modern chemical processes—are no problem with Burndy Connectors. They're engineered to meet specific operating conditions.



UTILITIES—Burndy serves the utility industry with 140 standard types of Power Connectors... for cable, tube, bar and special shapes... for copper and aluminum conductors... in power stations, in overhead and underground installations. Burndy equipment is basic in utility connecting systems.

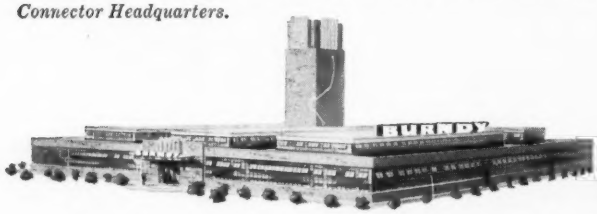


MINING—Underground heavy-duty wiring systems must be protected against dampness, vibration, dust. Where a short circuit might cut off fresh air, stop the shaft elevators, throw out the lighting, interrupt pumping, or even cause an explosion — unfailing operation of the electrical installation is literally a matter of life or death. Leading engineers specify Burndy Connectors.



PETROLEUM—Burndy Ground Connectors are used extensively in oil refineries to protect electrical installations to prevent fires and explosions that might be caused by sparks of static discharges or by lightning. Burndy Ground Connectors, of every type, are designed and manufactured as accurately as those which are called on to carry current continuously.

Burndy Connectors are specified because of their superior performance in joining, terminating, clamping, and grounding every size and functional variety of electrical conductor—from the smallest home wiring circuit to the largest industrial installations. Burndy engineering is continuously developing more and more efficient connecting methods. *Engineering graduates and students are welcome visitors at Burndy Connector Headquarters.*



BURNDY

BURNDY ENGINEERING COMPANY • NORWALK, CONNECTICUT • BURNDY CANADA LTD., TORONTO, ONT.

"WORLD'S LARGEST MANUFACTURER OF ELECTRICAL CONNECTORS"

ME...
an AIRCRAFT engineer?

But I haven't majored in aeronautical engineering

That doesn't matter. Lockheed can train you... at full pay!

It's your aptitude, your knowledge of engineering principles, your degree in engineering that count.

Those—plus the opportunity Lockheed is offering you—are all you need for a career as an aircraft engineer. In Lockheed's special program for engineering graduates, you may go back to school, or you may convert to aircraft work by doing—on-the-job training. But whichever it is, you receive full pay while learning.

But Lockheed offers you more than a career. It offers you a new life, in an area where living conditions are beyond compare. Outdoor living prevails the year-'round. Mountains, beaches are an hour from Lockheed.

See your Placement Officer today for the details on Lockheed's Aircraft Training Program for engineers, as well as the better living conditions in Southern California.

If your Placement Officer is out of the illustrated brochures describing living and working conditions at Lockheed, write M. V. Mattson, Employment Manager

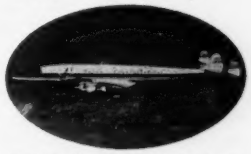
Lockheed Aircraft Corporation

Burbank, California

This Plane made History

The P-38 Lightning – first 400 mile per hour fighter-interceptor, the "fork-tailed Devil" that helped win World War II.

This Plane is making History



The Super Constellation – larger, faster, more powerful; the plane that bridges the gap between modern air transport and commercial jet transport.

This Plane will make History

This plane – which exists only in the brain of an engineer like yourself – is one reason there's a better future for you at Lockheed. For Lockheed will always need engineers with ideas, engineers with imagination, engineers who build the planes that make history.

Chrome-Lignin Soil Stabilization

By JOHN F. SCHMUTZ, ChemE '55

Professors J. C. Smith of the Cornell School of Chemical Engineering and B. H. Hough of the School of Civil Engineering have recently developed a method for chemically stabilizing soils known as the Chrome-Lignin process. Stabilization by this new method imparts to muddy and untrafficable soils such desirable qualities as strength, hardness, and low permeability.

During World War II, the Army faced the perennial and critical problem of transporting men, equipment, and supplies over muddy terrain in areas like Burma. On the advice of such leaders as General Stilwell, research was begun by the army engineers and others to find a way to stabilize muddy soils in order to make otherwise impassable areas trafficable. Processes for stabilizing soils with materials like cement and asphalt had been developed in the United States prior to World War II, but these methods were not suitable for emergency field use, especially in wet and muddy clays.

To meet this problem, Professor Hough in 1946 began a study of the effect of ion exchange on the fundamental properties of clay. He found that ion exchange involving very small amounts of chemicals added to the clay produced remarkable changes in the agricultural properties of clay, but almost no effect on the engineering properties. Soil conditioners like Krilium produce somewhat similar effects. To give soils the necessary engineering properties such as high bearing power and water resistance, large quantities of chemical additives must be used. These additives may amount to 3 to 10 per cent of the weight of the soil being treated. This implies that the additive must be commercially available in very large quantities if any appreciable amount of dirt is to be stabilized.

The Chrome-Lignin process is a promising answer to the problem of soil stabilization. It is based on the use of waste lignin from the sulfite paper mills and offers possibilities for solving the problem of disposing of waste lignin by pulp manufacturers. By the addition of a mixture of calcium ligno-sulfonate and potassium or sodium bichromate to moderately wet soils, they can be made stronger and almost completely impervious to water.

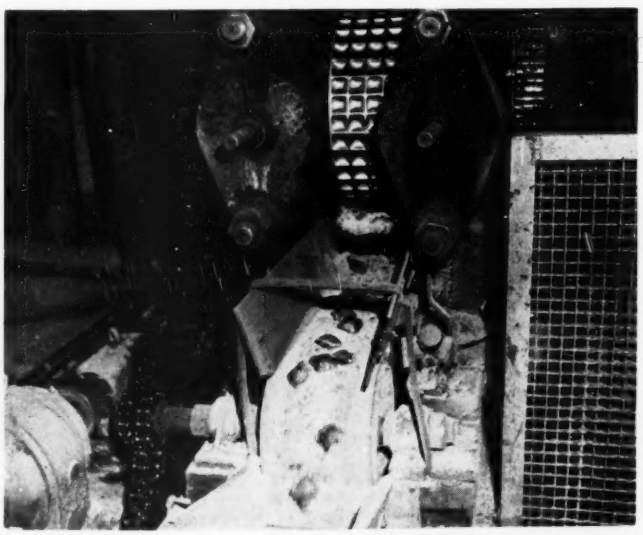
The exact mechanism of the stabilization of clays is not known. Sands are stabilized by the formation of an insoluble gel through the reaction between the sulfite waste and the bichromate. The reaction appears to be a simultaneous oxidation and polymerization of the lignin. The gel forms a matrix in which the sand particles are held. In fine-grained soils, like loams and clays, there is apparently a coordination reaction between the chromium atoms and the surface of the soil particles; the gel is bound to the soil, and the soil particles are bound chemically to each other. Unlike other stabilization methods, this reaction is not very sensitive; it will work with nearly all soils, even in surface loams which contain large amounts of organic matter. The reaction time can be varied from a few minutes to many hours to suit conditions.

By briquetting stabilized soils, an aggregate can be made which is suitable for road construction. This aggregate produces a solid road bed on which military vehicles can travel. In road construction, soil is first excavated near the impassable region. It is then mixed

(*Continued on Page 62*)

Briquettes, stabilized by the Chrome-Lignin process, being discharged from a briquetting machine.

—Harper H. Cox



Somebody ought to

speak sharply to Nature

THERE'S a lot of loose talk these days about profits, attacking them as though they were evil.

The very existence of the world depends on profits; the *improvement* of the world depends on *big* profits. A farmer plants one potato and usually gets back 15. Even allowing for all his costs, that's more than 1000% profit! He plants one pound of corn and gets back 336 pounds—that's 33,600% profit. These are big profits. Is that bad?

Should the farmer be scorned as anti-social? Should his "excess" profit (whatever that is) be taken away from him? Should he be told that from now on he must limit his "profit" to, say, 6%?

To legislate against profits is as silly as to legislate against things growing.

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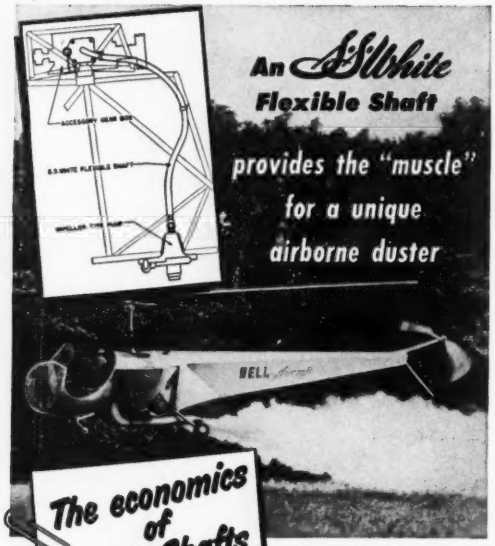

Courtesy Bell Aircraft Co., Buffalo, N. Y.

When the manufacturer of this crop-dusting helicopter wanted to transmit power from the accessory gear box to the insecticide pump, mounted some distance away, he chose an S.S.White flexible shaft to do the job. As the diagram shows, the shaft provides a simple one-piece coupling that can be readily run around intervening struts and frames.

* * * *

Many of the problems you'll face in industry will involve the application of power drives and remote control with the emphasis on low cost. That's why it will pay you to become familiar with S.S.White flexible shafts, because these "Metal Muscles"® represent the low-cost way to transmit power and remote control.

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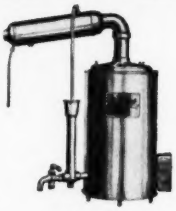

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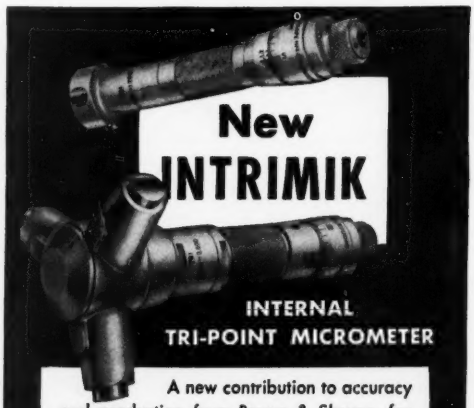

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THE DU PONT DIGEST

JOB WITH A FUTURE—

Supervising Production

Varied experiences in a Du Pont chemical plant fit young engineers for higher responsibility

As was pointed out in the last issue of the *Digest*, Du Pont's many product lines afford men interested in production supervision experience in a wide variety of operations.

For a better idea of what the work involves, let's consider a specific case —the production of "Mycoban" sodium and calcium propionates, inhibitors used by bakeries to extend the mold-free life of bread and other baked goods.

Many of the problems encountered in the manufacture of "Mycoban" are similar to those arising in the manufacture of any Du Pont chemical. There is the same continuing effort to improve quality, while cutting costs through the better use of equipment, instrument controls and raw materials.

The supervisor works hand in hand with the plant technical section toward these goals. He also keeps himself informed on technological and economic trends affecting production and sales, finds explanations for out-of-line costs, and prepares plans and estimates for increasing production.

Such work obviously calls for a sound technical background. In addition, however, considerable administrative ability is needed. A supervisor must be able to *supervise*. His duties include keeping people under him informed about long-range changes in company policy and assuming responsibility for their safety and morale.

Process Control Engineer *W. L. Morgan (at left), B.S. in Ch., West Virginia Wesleyan '37, observes packing characteristics of "Mycoban" powder as it comes from the loading hopper.*

Production Supervisor *Robert B. McCue (at right), B.S. in Ch. E., West Virginia '38, and plant laboratory shift-leader J. P. Quarles, B.S. in Ch. E., Lehigh '38, discuss analysis of a product sample.*

The unusual problems encountered in "Mycoban" production are largely due to the seasonal nature of its sales. Its greatest use is in the hot, humid months, or from late spring to early fall. For this reason:

1. Production and warehouse inventories of "Mycoban" must be carefully balanced against sales forecasts. The supervisor gathers necessary background information for this operation.

2. Production needs, including manpower, equipment and materials, must likewise be planned to meet sales forecasts.

3. Maintenance, including a yearly hydrostatic test of the plant, must be scheduled with the plant maintenance supervisor for the minimum interference with peak-season production. Emergency maintenance must be kept down by carefully planned preventive maintenance.

As you can see, production supervisors have a broad field of activity at Du Pont. The experience gained in this job will prepare an ambitious man for advancement to positions of still higher responsibility.

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Chrome-Lignin

(*Continued from Page 58*)

with chemicals and briquetted into an aggregate about two inches square. The briquettes harden fairly fast, and if necessary they may be crushed. Finally the hard briquettes are loaded onto trucks and dumped onto the muddy area. After the aggregate has set, the strength of the briquettes is relatively unaffected by water. Drying is not essential for developing strength after briquetting, but, by varying the initial chemicals, the strength of the briquettes can be altered.

Traffic Tests

In the summer of 1952, 500 tons of briquettes were tested under traffic. A small section of road made with stabilized briquettes effectively carried traffic across an otherwise impassable area. Although these tests were satisfactory, they showed that many problems in soil stabilization were still not solved. Chief among these problems is that of effectively mixing soil and chemicals. A new army research contract is now underway to find or develop suitable mixing equipment. The pictures accompanying this article show some of the production operation during the experiments in 1952.

The Chrome-Lignin process can also be used for the stabilization of beaches for amphibious operations. In such applications the chemicals, mixed with water, are merely pumped onto beaches. They quickly seep into the sand and set to form a solid foundation for military traffic. The Chrome-Lignin chemicals react rapidly; sand can be made to set in less than one hour.

The treated section of dirt road above withstood water and traffic while the untreated section, foreground, became rutted. Such surface treatments will last for several years.

—*Harper H. Cox*

The truck is being loaded with Chrome-Lignin briquettes for use in experimental road construction.

A similar process for treatment of loams and clays has been developed. During the summer, or whenever the soil is relatively dry, the area to be treated is tilled open. The stabilization chemicals are then pumped onto the soil in a manner similar to that used for beaches. Soil, stabilized in this way, retains its natural appearance, but never becomes muddy. Treated soil may retain its desirable qualities for several years. This method offers economical improvements for stabilized road shoulders, pathways, playgrounds, and barnyards. It provides a surface that looks like dirt, but never becomes muddy, at a cost no greater than that of cement or black top.

Liquid Chrome-Lignin chemicals are initially thin with a viscosity of 3 to 4 centipoises (water=1 cp.). They can be injected into very fine sands to stop the flow of water and give moderate bearing strengths. When the liquid is introduced into fully-saturated sands, it pushes the water out of the way and sets to seal the sand. It will go into much finer sands (even silts) than other chemical grouting liquids and has been known to travel 45 feet through sand under an initial head of 10 psi.

Possibilities

This permeability and sealing capacity has opened new possibilities for using the Chrome-Lignin process in sealing mines, excavating through sandy soils, and sealing levees. By spraying unused mine shafts in sandstone or porous rock with the Chrome-Lignin mixture, the walls can be completely sealed, making the mine suitable for storage of such things as propane. In excavating sandy soils, the Chrome-Lignin chemicals could be used to prevent cave-ins by stabilizing the sand before digging is begun.

Chemicals for the Chrome-Lignin process are relatively cheap. Most conditions require from 2 to 8 per cent chemical at a cost of from 8 to 35 cents per 100 pounds of soil treated. For surface treatment, a one-inch layer of stabilized soil costs from 10 to 15 cents per square yard. Under severe conditions, a road 20 feet wide would require from 5,000 to 10,000 tons of stabilized soil per mile at a cost of from $4,000 to $8,000 per mile. This compares favorably with the cost of secondary and tertiary roads in this country.

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STRESS and STRAIN...

Shortly before the invasion started, a general and his staff were watching a troop-carrying glider go by. From it came a carrier pigeon. Powerful field glasses followed the bird to a near-by field. A colonel raced over, got the bird, took the message from his leg, raced back, and breathlessly handed it to the general. He opened it with trembling hands, read it, cursed, and threw it on the ground. Then he walked away, his face a bright purple. The colonel waited a moment, then picked up the message. It read: "I have been sent down for being naughty in my cage."

• • •

And then there was the Arts student who let his M.E. roommate fix him up for a date with Allis-Chalmers.

• • •

The colonel was lecturing a class of incipient officers. "A forty-foot flag pole has fallen down," he said. "You have a sergeant and a squad of men. How do you erect the flagpole again?"

The candidates thought, then made suggestions about block and tackle, derricks, and so on.

"You're all wrong," said the colonel. "You'd say: 'Sergeant, get that flagpole up.'"

• • •

"Porter, get me another glass of ice water."

"Sorry, suh, but if I takes any mo' ice, dat corpse in the baggage car ain't going to keep."

• • •

Seven sailors and a lady, the only survivors of a shipwreck, were rescued from an island after five long years. One sailor was telling his experience to a minister friend. The minister asked, "And, my good boy, was the lady chaste?"

"Yes, she was," he replied. "And for a woman, she ran pretty well."

"My boy friend is serving on an island in the Pacific."

"Which one?"

"Alcatraz."

• • •

Three athletes from different schools had flunked their classes and were dropped from their teams. They got together and talked about their misfortunes.

The man from Cornell said, "That calculus was just too much."

The man from Princeton said, "It was trigonometry that got me."

The man from Penn said, "Did youse guys ever hear of long division?"

• • •

Prof: "Why aren't you taking notes?"

Student: "I don't have to. I've got my grandfather's."

"Go to school here?"

"Yeah."

"Frat man?"

"Yeah, SAE."

"So am I, but I don't remember you. Where do you sit at the meetings?"

"Second Row."

"Oh, that accounts for it. I'm up in the first balcony."

• • •

The other evening, a gentleman strolling through downtown Ithaca saw two quaint-looking old ladies hovering near a bar.

"Poor old things," he remarked to himself, "they're doubtless trying to work up courage to go in."

He sneaked up close to the antiquated pair and listened.

"Come on, Nellie," one of them pleaded, "Let's go in."

"No," the other one replied, "let's skip this one."

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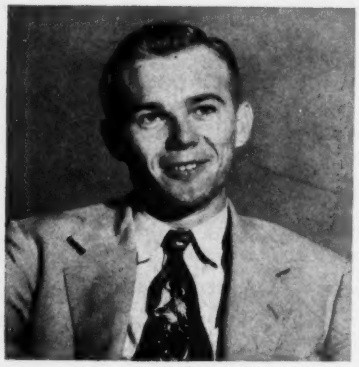
MY QUESTION TO THE G-E STUDENT INFORMATION PANEL:



"What educational training opportunities are available to engineers in General Electric?"

. . . JAMES H. ROBBINS, University of Florida, 1953

The answer to Mr. Robbins' question, presented at a student information meeting held in July, 1952 between G-E personnel and representative college students, is printed below. If you have a question you would like answered, or seek further information about General Electric, mail your request to College Editor, Dept. 221–6, General Electric Co., Schenectady, N. Y.

M. M. BORING, *Engineering Services Division* . . . In General Electric the engineer has his choice of engaging in either Company education programs or in graduate study in nearby colleges and universities.

The Company programs are based on material directed toward better fitting the engineer for a career with the Company. He will gain first-hand knowledge of industry, come in contact with many different products and types of work, and associate with top-flight engineers.

General Electric actively encourages college graduate study, and when this study applies to the individual's work, on approval by his departmental manager, provisions are made for refunds of one-half tuition costs upon satisfactory completion of courses.

The technical education programs in G.E. may be divided into two main categories: the advanced technical programs, where carefully selected students (any engineer may apply) are given intensive training; and the general and specialized technical courses, available to all Company engineers.

The objective of the advanced technical programs—Creative Engineering, Advanced Engineering, and Process Technology—is to impart an understanding of fundamental scientific principles and their application to particular problems, as well as to encourage a basic approach to these problems and promote confidence in the engineer's own ability.

The Creative Engineering Program is directed toward developing creative and inventive abilities, and a logical approach to design problems by definition, search, selection, and evaluation.

Organized to develop top-flight engineers, the Advanced Engineering Program provides an opportunity to study fundamental physical principles and advanced mathematical methods in the areas of electrical and mechanical engineering.

The Process Technology Program, concerned with chemical, chemical engineering, and metallurgical fields, acquaints the engineer with laboratory and engineering groups, with activities in many locations, and with various product businesses of the Company.

The category that includes the general courses is designed to acquaint engineers with the engineering aspects of marketing, manufacturing, and application engineering as well as providing less intensive courses on fundamental principles. The specialized technical courses provide intensive study for engineers permanently assigned to operating departments in such fields as servomechanics, heat transfer, and magnetic design.

In addition, educational opportunities are offered engineers by our Manufacturing, Marketing, Employee and Plant Community Relations, and other divisions.

Besides having the opportunity for educational development, the engineer in General Electric is given a good job with plenty of responsibility, sound training for a lifetime career, opportunities for careers in widely varied phases of science and engineering, a good place in which to work, and a place in which to lead a well-rounded life.

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